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Comparison of Anxiety Between Smokers and Nonsmokers with Acute Myocardial Infarction

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Abstract
Background: Increased anxiety correlates with increased complications after acute myocardial infarction. Anxiety levels and use of anxiolytic agents have not been compared between smokers and nonsmokers hospitalized because of acute myocardial infarction.

Objectives: To compare anxiety level, sociodemographic factors, and clinical variables between smokers and nonsmokers hospitalized with acute myocardial infarction and to examine predictors of use of β-blockers and anxiolytic agents among smokers and nonsmokers.

Methods: Secondary data analysis of a prospective multisite study on anxiety in 181 smokers and 351 nonsmokers with acute myocardial infarction. Anxiety was measured by using the State Trait Anxiety Inventory and the anxiety subscale of the Basic Symptom Inventory within 72 hours of admission.

Results: Smokers reported higher anxiety levels than nonsmokers reported on both anxiety scales. Female smokers reported the highest anxiety and peak pain levels of all, yet women were the least likely to receive anxiolytic agents. Smoking status was not a predictor for anxiety level when sex, peak pain, use of β-blockers in the hospital, and age were controlled for. However, smokers were twice as likely as nonsmokers to receive an anxiolytic agent and 60% more likely to receive a &beta-blocker in the emergency department, and smokers were 80% more likely than nonsmokers to receive an anxiolytic agent during hospitalization when these variables were controlled.

Conclusions: Older female smokers are at risk for complications because they are older than their male counterparts and less likely to receive &beta-blockers and antianxiety medications in the emergency department.

Disciplines
Cardiology | Cardiovascular Diseases | Circulatory and Respiratory Physiology | Critical Care | Critical Care Nursing | Health and Medical Administration | Health Services Research | Medical Humanities | Medical Sciences | Medicine and Health Sciences | Nursing | Preventive Medicine

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• Background *Increased anxiety correlates with increased complications after acute myocardial infarction. Anxiety levels and use of anxiolytic agents have not been compared between smokers and nonsmokers hospitalized because of acute myocardial infarction.*

• Objectives *To compare anxiety level, sociodemographic factors, and clinical variables between smokers and nonsmokers hospitalized with acute myocardial infarction and to examine predictors of use of β-blockers and anxiolytic agents among smokers and nonsmokers.*

• Methods *Secondary data analysis of a prospective multisite study on anxiety in 181 smokers and 351 nonsmokers with acute myocardial infarction. Anxiety was measured by using the State Trait Anxiety Inventory and the anxiety subscale of the Basic Symptom Inventory within 72 hours of admission.*

• Results *Smokers reported higher anxiety levels than nonsmokers reported on both anxiety scales. Female smokers reported the highest anxiety and peak pain levels of all, yet women were the least likely to receive anxiolytic agents. Smoking status was not a predictor for anxiety level when sex, peak pain, use of β-blockers in the hospital, and age were controlled for. However, smokers were twice as likely as nonsmokers to receive an anxiolytic agent and 60% more likely to receive a β-blocker in the emergency department, and smokers were 80% more likely than nonsmokers to receive an anxiolytic agent during hospitalization when these variables were controlled.*

• Conclusions *Older female smokers are at risk for complications because they are older than their male counterparts and less likely to receive β-blockers and antianxiety medications in the emergency department. (American Journal of Critical Care. 2006;15:617-625)*

Each year, an estimated 700 000 persons in the United States have their first acute myocardial infarction (AMI) and about 500 000 have a recurrent infarction.[1] Tobacco use remains a major risk factor in coronary heart disease, contributing to 33.5% of deaths annually, and an estimated 35 000 nonsmokers die of coronary heart disease as a consequence of exposure to environmental tobacco smoke.[2,3] The prevalence of coronary heart disease and AMI is projected to increase by 2010, when 40 million Americans will be aged 65 years or older.[1]

No studies comparing anxiety levels between smokers and nonsmokers hospitalized for an AMI have been reported. Because AMI is associated with a high level of anxiety and many patients with AMI are smokers, the primary purpose of this study was to

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compare anxiety levels between smokers and nonsmokers hospitalized for AMI. A secondary aim was to determine whether use of anxiolytic agents and β-blockers differs between smokers and nonsmokers when anxiety level, peak pain level, sex, and age are controlled.

Patients with an AMI usually experience high levels of anxiety.[4-8] Some level of anxiety is a normal response when one is confronted with a sudden health event such as an AMI. A sustained high anxiety level, however, is associated with detrimental health outcomes and increased in-hospital complications, including ventricular arrhythmias and death.[5,9-11] A psychophysiological stress perspective was used to guide this study because smoking increases arousal of the autonomic nervous system and smokers, as a group, tend to be more anxious. However, in their review of the psychophysiological assessments of stress, Katkin et al[12] emphasize that stress reactivity is highly individualistic. Some individuals respond to stressful situations with greater autonomic arousal (increased heart rate and blood pressure) than do nonreactors, and the tendency to react to stressful events seems to be a stable enduring "traitlike" characteristic. Researchers hypothesize that this β-adrenergic hyperreactivity pattern is a critical factor in hypertension, which often precedes AMI.

Smoking increases autonomic system arousal; smokers tend to be more anxious.

Certain medications (eg, β-blockers and anxiolytic agents) are recommended treatment for AMI patients. According to clinical guidelines of the American Heart Association, all AMI patients should receive β-blockers during hospitalization and after discharge from the hospital.[1] Consequently, studies of anxiety among AMI patients should include controls for the administration of β-blockers because these medications have antianxiety properties along with the anxiolytic agents.

Results of studies on the link between smoking behavior and anxiety are conflicting. Some researchers have reported a link between smoking behavior and anxiety states and disorders.[13,14] Patton et al[15] found that a subpopulation of smokers is more anxious than other smokers. Other investigators[16-19] have shown that nicotine can act as an anxiolytic agent and as an antidepressant. Smokers consistently attribute their smoking to its ability to reduce subjective stress and anxiety.[20-23] Kassel and Shiffman[24] found that smoking reduced anxiety only when paired with a distracting activity. Recent studies[13,25] link smoking more strongly with panic disorder, a specific anxiety disorder. Smokers with an AMI often have additional comorbid conditions (eg, hypertension, lung disease) that increase their risks for adverse health outcomes. An examination of the relationships between anxiety level and smoking status may provide additional clinical information about this high-risk group.

The questions addressed by this study were as follows:

- Do smokers report higher levels of anxiety than their nonsmoking counterparts?
- Do smokers receive more antianxiety medications than nonsmokers during hospitalization?

Methods

Design

The data for this study are from a cross-sectional, prospective, comparative multicenter study that investigated differences in anxiety and clinical outcomes between male and female patients with an AMI.[8]

Sample and Setting

The study was conducted at 4 urban university medical centers and 2 private hospitals in the United States and 1 tertiary teaching hospital in Australia. The convenience sample included 532 patients admitted to the coronary care unit who had a diagnosis of AMI confirmed by elevated cardiac enzyme levels and electrocardiographic changes compatible with an AMI. Participants were in a stable medical condition (eg, no pain, no life-threatening dysrhythmias or perfusion problems), were able to communicate coherently, and had no comorbid conditions such as sepsis, stroke, or acute renal or liver failure. Study site facilities did not provide adjunctive therapy for smoking cessation at the time the data were collected, and tobacco cessation was not the focus of the original study.

Procedure

Data were collected by cardiovascular nurses trained in interviewing techniques and data abstraction from medical records. Interviews were conducted within 72 hours of admission when patients were in stable condition and free of pain. Integrity of the interview data was maintained across study sites by using a standardized protocol interview and data collection form. Clinical and demographic data were abstracted from the medical record. A detailed description of the original study protocol approved by the institutional review board is provided elsewhere.[8] The original data set was used with no modification of the variables.

Measures

Anxiety. Anxiety was evaluated by using the State Anxiety Inventory (SAI) from the State Trait Anxiety Inventory[26] questionnaire and the Brief Symptoms Inventory (BSI) 6-item anxiety subscale by Derogatis and Melisaratos.[27] Two instruments were used to measure each patient's state anxiety to ensure that the results accurately reflected state anxiety in this sample. Both instruments, especially the SAI, have been widely used individually in previous research to measure state anxiety in patients with AMI, but no reports of both instruments being used together have been published. A person's state anxiety is a measure of anxiety at the time the instrument is completed, whereas the trait anxiety is a measure of how the person generally feels. Trait anxiety and state anxiety are highly correlated.[26]

The reliability and validity of the SAI have been supported for healthy and ill populations.[26] The SAI α coefficients for internal consistency reliability range from .86 to .95, and the SAI has established content, concurrent, and construct validity.[26] The SAI consists of 20 statements that are rated on a 4-point gradient scale from 1 (not at all) to 4 (very much). The 20 item scores are summed with a total score that can range from 20 (low anxiety) to 80 (high anxiety). In previous studies, normative values for persons 50 to 69 years old were 34.5 (SD 0.3) for men and 32.2 (SD 8.7) for women.[26] The mean score for general medical surgical patients was 42.4 (SD 13.8), and the mean score for medical surgical patients with psychiatric comorbid conditions was 47.7 (SD 3.2).[26]

The BSI is a 53-item self-report questionnaire used to assess multiple dimensions of psychological distress.[27] The BSI was derived from the Symptom Checklist-90-R to provide a psychometrically sound shorter instrument. The BSI anxiety subscale and the Symptom Checklist-90-R have a correlation of 0.95.[27] The BSI anxiety subscale, consisting of 6 items rated on a 5-point scale, was used for this study. Responses on how much the subject is distressed by the signs and symptoms of anxiety range from 0 (not at all) to 4 (extremely). Item scores are summed, and the mean is calculated to provide a total score ranging from 0 to 4, with higher scores indicating higher anxiety levels. Normative values for the BSI anxiety dimension are 0.35 (SD 0.45) for healthy persons, 1.7 (SD 1.15) for psychiatric inpatients, and 1.7 (SD 1.0) for psychiatric outpatients. The content, convergent, and construct validities of the BSI have been established.[28] Internal consistency reliability analyses for the 2 anxiety measures for this study were calculated. The Cronbach α values were .87 for the BSI and .61 for the SAI. The Pearson correlation for the 2 scales for the study sample was 0.71 ($P<.001$).

Sociodemographic Characteristics. Sociodemographic data were collected by interview. The data included patients' sex, race, age, marital status, work status, annual income, and education level.

Clinical Data. Detailed clinical information was collected on comorbid conditions (hypertension, diabetes, previous AMI, smoking, angina, history of bypass graft surgery, angioplasty, and diagnosis of coronary heart disease without prior event) and complications (including ventricular fibrillation, ventricular tachycardia, congestive heart failure/pulmonary embolism, sudden death, asystole, supraventricular tachycardia, atrioventricular block, sinus bradycardia and recurrent ischemia, reinfarction, cardiogenic shock, and noncardiac death).

Smoking. Data on smoking were collected by asking the patient whether he or she currently smoked. Data on the number of cigarettes per day or the years of smoking were not collected.

Patterns of Use of Medications. Data on the use of anxiolytic agents and β-blockers in the emergency department and during hospitalization were extracted from the medical records by nurses trained in cardiac research. Medication use was coded as yes or no.

Peak Pain. Peak pain was assessed by asking patients to rate the intensity of the pain they experienced during their initial event on a scale of 0 to 10, with 0 being no pain and 10 being the most pain. This simple rating scale is easily administered and understood and is applicable in the clinical setting.

Data Analysis

The data were first analyzed descriptively by using means and SDs or frequency distributions, as appropriate. The Cronbach α was used to assess internal consistency of scale items. Bivariate comparisons were accomplished by using χ^2 tests of association or independent samples *t* tests. Multiple linear regression was used to determine whether smokers and nonsmokers differed on anxiety after controlling for the demographic characteristics of age, sex, peak pain, and use of β-blockers. Multiple logistic regression was used to discern differences in use of β-blockers and anxiolytic medications between smokers and nonsmokers, controlling for patients' peak pain level, sex, age, and anxiety. The Hosmer-Lemeshow goodness-of-fit test was used to assess the fit of the logistic models to the data. For each of the regression analyses, variance inflation factors were estimated for each of the predictors, and levels of multicollinearity were assumed to be acceptable because all variance inflation factors were less than 4.[29] All data analyses were performed by using SPSS for Windows (version 12.0)[30]; *P* values of .05 or less were deemed acceptable.

Table 1 Demographic characteristics of smokers and nonsmokers included in the study*

Characteristic	Total sample (N = 532)	Smokers (n = 181) (34%)	Nonsmokers (n = 351) (66%)
Age, mean (SD), y	61.9 (13.5)	54.5 (12.7)	65.4 (12.3)†
Education, mean (SD), y	12.8 (3.1)	12.9 (2.83)	12.8 (3.36)
Sex			
Male	354 (67)	128 (71)	226 (65)
Female	177 (33)	53 (29)	124 (35)
Marital status			
Married	369 (70)	118 (66)	251 (72)
Not married	161 (30)	61 (34)	100 (28)
Race			
White	462 (87)	150 (83)	312 (89)
Nonwhite	67 (13)	30 (17)	37 (11)
Income level, $			
≤20,000	171 (36)	47 (29)	124 (40)
20,001-59,999	235 (50)	93 (57)	142 (46)
≥60,000	68 (14)	24 (15)	44 (14)

*Values are No. (%) of patients unless otherwise indicated. Data were not available for all characteristics for all groups. For example, data on income level were available for only 310 of the 351 nonsmokers. All percentages are calculated on the basis of the number of respondents for that characteristic. Percentages may not total 100 because of rounding.

†$P < .001$.

Results

Table 1 shows the demographic characteristics of the sample (N = 532), which comprised 181 smokers (34%) and 351 nonsmokers (66%) recruited from multiple clinical sites. The mean number of days hospitalized did not differ significantly ($P = .37$) between smokers (5.7 [SD 4.34] days) and nonsmokers (6.0 [SD 4.55] days). The sample was predominantly male, white, and married, with a mean education level of 12.8 (SD 3.1) years. The only significant difference ($P < .001$) between the groups was in age: smokers (54.5 [SD 12.7] years) were younger than nonsmokers (65.4 [SD 12.3] years).

Smokers reported higher levels of anxiety than nonsmokers; female smokers reported the highest anxiety levels.

One fourth of the sample had a history of a previous AMI. Nonsmokers were almost twice as likely as smokers to report a previous AMI (odds ratio = 1.9, 95% CI 1.35 to 2.78; $P < .001$). However, when anxiety levels were compared between patients who previously had an AMI and patients who had not, no significant differences were detected with either anxiety scale. Nonsmokers also tended to experience more complications than smokers (mean number of events: 0.98 [SD 1.29] for nonsmokers vs 0.76 [SD 0.92] for smokers; $P = .05$).

Smokers reported significantly higher levels of anxiety than nonsmokers when anxiety was measured by using the SAI and the BSI anxiety subscale (Table 2). The mean peak pain level was higher in smokers (7.4 [SD 2.78]) than in nonsmokers (6.8 [SD 2.67]; $P = .01$) when evaluated on a scale of 0 to 10, with 10 representing the highest possible pain level. The anxiety scores on both scales and the peak pain scores were significantly higher in women than in men. Female smokers reported the highest anxiety and peak pain levels compared with male smokers and all nonsmokers.

Smokers received anxiolytic agents in the emergency department and hospital more often than nonsmokers did.

Medication differences between smokers and nonsmokers were examined by using χ^2 analyses (Table 3). The administration of anxiolytic agents in the emergency department or on an as-needed basis did not differ significantly between smokers and nonsmokers. Both smokers and nonsmokers were more likely to receive a β-blocker (46%) than an anxiolytic agent (32%) in the emergency department. More than half of smokers (53%) received a β-blocker in the emergency department compared with only 42% of nonsmokers ($\chi^2 = 5.1$, $P = .02$).

More than one third (37%) of men received an anxiolytic agent in the emergency department, compared with less than a fourth (23%) of women ($\chi^2 = 9.8$, $P = .002$). Administration of β-blockers in the emergency department did not differ significantly between men and women among smokers or nonsmokers. When male and female smokers were compared with respect to medications administered in the emergency department, 42% of male smokers received an anxiolytic compared with 21% of female smokers ($\chi^2 = 6.9$, $P = .008$), and male smokers (58%) were more likely than female smokers (40%) to receive a β-blocker ($\chi^2 = 4.4$, $P = .03$). After the emergency department, however, differences

Table 2 Comparisons of scores for anxiety and peak pain levels by smoking status and sex of patient*

Measure	Total sample (N = 532)	Smokers (n = 181)			Nonsmokers (n = 351)		
		Total	Male	Female	Total	Male	Female
State anxiety	51.9 (14.8)	54.4 (14.9)†	52.7 (5.3)	58.2 (13.4)†	50.6 (14.6)	49.2 (15.2)	53.1 (13.4)†
Brief Symptoms Inventory anxiety	1.4 (1.17)	1.6 (1.18)†	1.4 (1.18)	2.0 (1.13)†	1.3 (1.15)	1.2 (1.10)	1.5(1.22)†
Peak pain	7.0 (2.55)	7.4 (2.78)†	7.1 (2.30)	8.1 (2.07)†	6.8 (2.67)	6.6 (2.53)	7.1 (2.88)†

*All values are mean (SD) of the scores on that measure.
†Significant difference ($P < .05$) between smokers and nonsmokers.
‡Significant difference ($P < .05$) between men and women.

Table 3 Chi-square comparisons of medications administered in smokers and nonsmokers*

Medication	Total sample (N = 532)	Smokers			Nonsmokers		
		Total (n = 181)	Male (n = 128)	Female (n = 53)	Total (n = 351)	Male (n = 226)	Female (n = 124)
Anxiolytic agent in emergency department	167 (32)	64 (36)	53 (42)	11 (21)	103 (30)	74 (34)	29 (24)
Anxiolytic agent as needed	246 (47)	92 (52)	66 (53)	26 (50)	154 (44)	101 (45)	53 (43)
β-blocker in emergency department	236 (46)	92 (53)†	72 (58)	20 (40)	144 (42)	91 (41)	53 (43)
β-blocker in hospital	449 (85)	156 (87)	108 (86)	48 (91)	293 (84)	185 (82)	108 (87)

*All values are No. (%) of patients; percentages are based on the n for each variable, which in some cases is less than the total reported in the column heading because of missing data.
†Significant difference ($P < .05$) between smokers and nonsmokers.

in use of β-blockers during hospitalization related to smoking status or sex of the patient were not significant. Use of β-blockers is a universally standard clinical protocol for patients with AMI, and 85% of the patients in this study received this medication.

Next, multiple regression analysis was used to determine whether smokers and nonsmokers differed in anxiety levels when we controlled for age, sex, peak pain level, and use of β-blockers during hospitalization. Two separate regression models were run with the total state anxiety score after AMI as the dependent variable for one of the models and the total scores of 6 BSI anxiety subscale items as the dependent variable for the other model (Table 4). Smoking status was not significant in either model after we controlled for the patient's age, sex, peak pain level, and use of β-blockers. The number of cases included in these models was less than the total sample because data for some of the participants were missing on one or both anxiety measures. Sociodemographic characteristics did not differ between the subjects included in the regression models and the total sample. Because the age and proportion of smokers differed between men and women, sex-age and smoke-sex interaction variables were included in the 2 regression models; these variables were not significant and consequently were deleted in the final models.

Differences between smokers and nonsmokers with respect to use of anxiolytic agents and β-blockers in the emergency department and during hospitalization were examined by using logistic regression analysis (Table 5). Separate models were constructed with the 4 patterns of medication use as dependent variables, smoking status as the predictor variable, and state anxiety, BSI anxiety subscale, peak pain level, sex, and age of the patient included as control variables. Even after these personal and demographic characteristics were controlled for, smokers were more likely than nonsmokers to receive an anxiolytic agent in the emergency department and as needed in the hospital (odds ratio = 1.78, 95% CI 1.11 to 2.84, $P = .01$); smokers also were more likely than nonsmokers to receive a β-blocker in the emergency department (odds ratio = 1.62, 95% CI 1.02 to 2.60, $P = .04$). Use of β-blockers in the hospital did not differ significantly

Table 4 Results of multiple regression analysis to compare anxiety levels between smokers and nonsmokers, with peak pain levels, use of β-blockers, sex, and age of patients controlled for

Outcome variable	Adjusted R^2	F	*P*	Covariates	Standard β	*P*
State Trait Anxiety Inventory (n = 398)	0.0069	6.9	<.001	Smoking status	0.060	.26
				Peak pain	0.128	.01*
				Female sex = 0	-0.159	.002*
				β-blocker (hospital)	-0.061	.21
				Age	-0.170	.002*
Brief Symptoms Inventory (n = 401)	0.101	10.0	<.001	Smoking status	0.035	.49
				Peak chest pain	0.215	.001*
				Female sex = 0	-0.149	.003*
				β-blocker (hospital)	-0.017	.720
				Age (y)	-0.176	.001*

* Significantly different between smokers and nonsmokers.

Table 5 Odds ratios and 95% CIs for logistic regression models to determine differences between smokers' and nonsmokers' use of medications, with anxiety, peak pain level, age, and sex controlled for*

	In emergency department				In hospital			
	Anxiolytic (n = 390)		β-blocker (n = 392)		Anxiolytic as needed (n = 394)		β-blocker (n = 398)	
Variable	Odds ratio	95% CI	Odds ratio	95% CI	Odds ratio	95% CI	Odds ratio	95% CI
Smoker	2.0†	1.2-3.4	1.6†	1.0-2.6	1.8†	1.1-2.8	1.1	0.6-2.3
Brief Symptoms Inventory anxiety	0.9	0.6-1.1	1.1	0.9-1.5	1.0	0.8-1.3	1.0	0.7-1.5
State anxiety	1.0	1.0-1.1	1.0	1.0-1.0	1.0	1.0-1.0	1.0	1.0-1.0
Age	1.0	1.0-1.0	1.0	1.0-1.0	1.0	1.0-1.0	1.0‡	0.9-1.0
Peak pain	0.8†	0.8-0.9	0.9†	0.8-1.0	0.9†	0.8-1.0	1.0	0.9-1.1
Sex	2.1‡	1.2-3.6	1.1	0.7-1.7	1.1	0.8-1.8	0.5†	0.3-1.0

*The sample size in the heading of each column is the number of cases with complete data on all variables in the regression and thus is the effective sample size for that model.
†$P < .05$.
‡$P < .01$.

between smokers and nonsmokers. All medication models were examined for an interaction between sex of the patients and smoking. These models are not reported because the variance inflation factors were 9 or greater, indicating unacceptable levels of multicollinearity.[29]

Discussion

In this study, we examined whether 2 important universal clinical variables for patients hospitalized because of AMI (the level of anxiety experienced and the use of anxiolytics and β-blockers to reduce anxiety) differed significantly between smokers and nonsmokers. Medications are an important treatment for AMI patients. When no contraindications are apparent, β-blockers are a universal standardized treatment after AMI because they reduce morbidity and mortality rates.[1] One effect of β-blockers is their ability to reduce anxiety. Antianxiety medications are also frequently given to AMI patients to calm the patients' emotional state.[31] For this reason, studies measuring anxiety in patients with AMI should examine the combined effects of β-blockers and antianxiety agents.

The high anxiety scores of these AMI patients are consistent with the findings in other studies.[4-8] These AMI patients' mean SAI anxiety levels were higher (51.9) than reported normative values for males and

females of a similar age group (34 and 32).[26] The bivariate analyses of this multicenter study show that smokers reported significantly higher anxiety levels than nonsmokers reported when the 2 groups were asked about their anxiety level within 72 hours after hospitalization for an AMI. The mean state anxiety level of smokers was 54.4 compared with 50.6 for nonsmokers; female smokers reported the highest mean anxiety scores (58.2).

Anxiety symptoms in smokers may have been related to nicotine withdrawal.

However, regression models for the 2 anxiety measures indicated that after peak pain level, age, and sex of the patient were controlled for, smokers and nonsmokers did not differ significantly on these outcomes. Smoking status was not a significant variable in either model. Conversely, when the use of a β-blocker or an anxiolytic agent in the emergency department and as needed during hospitalization was examined with logistic regression (Table 5), a different picture emerged. Smokers were twice as likely to receive an anxiolytic agent in the emergency department, more than 60% more likely to receive a β-blocker in the emergency department, and 80% more likely to receive an anxiolytic agent as needed during hospitalization when we controlled for anxiety level, age, peak pain level, and sex of the patient. Smokers may have had more signs and symptoms of anxiety if they were experiencing the onset of nicotine withdrawal during the admission to the emergency department and throughout hospitalization. They may have more readily vocalized their anxiousness to the clinicians and consequently received more anxiolytic or β-blocker medications both in the emergency department and in the hospital. Their higher anxiety levels associated with an AMI event may be explained by the psychophysiological stress perspective that smokers may respond to stressful situations with greater autonomic arousal (increased heart rate and blood pressure) than nonsmokers do. This theory is plausible, because many smokers also have hypertension, and one theory of hypertension is that hypertensive persons have increased autonomic arousal reactivity.

Another interesting finding in this study was that patients with reported lower levels of peak pain were more likely to receive an anxiolytic agent and a β-blocker in the emergency department as well as an anxiolytic agent as needed during hospitalization when we controlled for anxiety levels, smoking status, age, and sex of the patient. The patients' recall of the peak pain intensity may have been altered by the use of the anxiolytic agent or β-blocker as needed during hospitalization. Men were more likely than women to receive an anxiolytic agent in the emergency department, and, conversely, women were more likely than men to receive a β-blocker in the hospital when we controlled for the same variables. With bivariate analysis, male smokers were more likely than female smokers to receive both an anxiolytic agent and a β-blocker in the emergency department. Age was a significant predictor of use of β-blockers during hospitalization.

Nonsmokers were about 10 years older than smokers, a difference that may explain why the nonsmokers were more likely to have a history of previous AMI and more complications than smokers. Unlike the findings in studies in which smokers and nonsmokers were compared, education or income did not differ between smokers and nonsmokers in this multisite study. Smokers usually have lower education and income levels than nonsmokers do.[3] Income is more likely to be site-specific for this sample and thus conveys less information about true socioeconomic status, especially since one site was outside the United States.

Males were more likely than females to receive an anxiolytic agent in the emergency department.

Limitations

These findings must be viewed with caution because anxiety and pain data were collected retrospectively by asking patients to recall their physical and emotional states after the event. Participants may have been under the influence of medications (eg, β-blockers, antianxiety medications, analgesic agents) that may have reduced their anxiety when they provided their recollection of the acute event. Smokers may have been experiencing nicotine withdrawal during data collection because adjunctive treatment for nicotine cessation was not a standard of care at the time of data collection.

Smoking data were not quantified, and the use of other tobacco products was not elicited. A dose response often occurs with smoking cessation; more addicted

smokers, those who smoke more each day and have more pack years, usually experience higher anxiety levels when deprived of nicotine than do less addicted smokers.[32] Measuring true nicotine consumption is difficult because the number and depth of inhalations are variable among those who smoke the same number of cigarettes per day. However, self-reports of smoking status are both sensitive (87.5%) and specific (89.3%) when compared with biochemical tests (eg, cotinine assays of serum, saliva, or hair).[33]

Other studies suggest that because of decreasing social acceptability and tolerance for secondhand smoke, smokers often underreport tobacco use.[34] Smokers with comorbid anxiety, psychiatric, or alcohol use disorders may experience increased anxiety when deprived of nicotine. Also, some patients may have more marked objective signs of anxiety (eg, increased heart rate and blood pressure). Consequently, clinical staff may interpret these objective signs and administer medications without validating the patient's state of mind.

Clinical Implications

Despite the limitations of this secondary data analysis, the findings of this initial comparison of anxiety levels between smokers and nonsmokers suggest that all AMI patients, but especially smokers, should be closely monitored for objective and subjective signs of anxiety. Periodically, they should be asked about their anxiety level and should be given antianxiety medications as appropriate.[35,36] Kim et al[8] and others[37] report that women have higher anxiety levels than men do, and the findings of this study suggest that female smokers are a high-risk group for complications because this group reported the highest anxiety levels but were less likely to receive antianxiety medications. During hospital admission and orientation, AMI patients should be informed that it is important for them to report feelings of anxiousness and that it is appropriate to ask for antianxiety medication.

Additional studies are needed to examine further the relationships between smoking status, anxiety levels, and medication use with diverse ethnic samples. Smokers and nonsmokers from different ethnic groups may report the experience of anxiety differently. Their different experiences may affect clinical outcomes. Anxiety levels should be examined with a group of smokers who receive pharmacological cessation therapy during hospitalization. Studies employing a biochemical measure of nicotine addiction and both the behavioral and physiological components of anxiety may elucidate a clearer understanding of these relationships and consequent clinical outcomes.

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