Relationship Between Preoperative Anxiety and Atrial Fibrillation After Coronary Artery Bypass Graft Surgery

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ABSTRACT

Background: Atrial fibrillation is a form of arrhythmia that frequently occurs after coronary artery bypass graft surgery. Psychological factors may be involved in the development of atrial fibrillation, although the specific effect of anxiety remains unclear.

Purpose: This study was designed to evaluate the relationship between preoperative anxiety levels and atrial fibrillation after coronary artery bypass graft surgery.

Methods: This descriptive design study recruited a sample of 126 patients. The data were collected by the researcher using a patient information form and the State-Trait Anxiety Scale.

Results: Atrial fibrillation developed in 26.5% of the sample. Those who developed atrial fibrillation had a mean trait anxiety scale score of 40.2 ± 7.8, which is statistically significant. According to the results of logistic regression, it was observed that increased trait anxiety score, increased age, presence of comorbid disease, and noncompliance with respiratory physiotherapy increased the risk of developing atrial fibrillation.

Conclusion/Implications for Practice: Preoperative anxiety levels were shown to be a significant factor promoting the development of atrial fibrillation after coronary artery bypass graft surgery. The results support measuring anxiety levels in patients as a standard procedure before performing this surgical procedure.

KEY WORDS:
atrial fibrillation, anxiety, coronary artery bypass.

Introduction

Coronary artery bypass graft (CABG) surgery is a significant treatment method for improving quality of life in patients with coronary artery disease (Ramesh et al., 2017). Atrial fibrillation (AF) is among the common arrhythmias occurring after CABG, often presenting on the second and third postoperative days (Folla et al., 2016).

The mechanism responsible for AF after open heart surgery is still not yet fully understood (Ismail et al., 2017). Risk factors such as age, hypertension (HT), obesity, diabetes mellitus (DM), prolonged pump and cross-clamp times, and prolonged ventilation for more than 24 hours have been associated with the development of postoperative AF (Gill et al., 2014; Omer et al., 2016). Patients with postoperative AF may develop complications such as stroke, pneumonia, respiratory failure, and congestive heart failure. In intensive care, it may lead to prolonged intensive care unit stays and hospital stays, increased healthcare costs, and reduced quality of life in patients (Folla et al., 2016; Ismail et al., 2017; Thompson et al., 2014).

Open heart surgery can be both a physically and psychologically stressful experience for patients. While waiting for vital organ surgery, patients may experience fear, anxiety, and uncertainty about the outcome of their operations (Ramesh et al., 2017). Psychological stress has been discussed as a trigger of AF for many years (Svensson et al., 2017), and psychological factors have been posited as contributing to the development of AF (Galli et al., 2017; Svensson et al., 2017). Anxiety is generally defined as a psychobiological state and reaction consisting of irritability, worry, sadness, unpleasant tension, and autonomic nervous system activation. Anxiety-related changes in the autonomic nervous system result in an increase in sympathetic tone, a decrease in vagal tone, and presentation of the cardinal symptoms of anxiety. An increase in sympathetic tone and a decrease in vagal tone may be factors that trigger the development of postoperative AF. A strong relationship has been shown between anxiety and the
development and recurrence of AF (Severino et al., 2019). However, the role of anxiety has yet to be sufficiently clarified (Galli et al., 2017; Svensson et al., 2017). For example, Feng et al. (2020) reported finding no evidence of a relationship between anxiety and AF. In a systematic review study, the role of psychological factors in AF was extensively investigated, but no clear conclusion was reached (Galli et al., 2017). Another systematic review study concluded that the incidence of anxiety in patients with AF increased because of deteriorating quality of life, but the role of anxiety as a trigger of AF was not investigated in detail. There is a complex relationship between anxiety and AF. It has been reported that AF may cause anxiety in patients and anxiety may create a favorable environment for the development of AF (Patel et al., 2013).

No studies to the knowledge of the authors have explained clearly the relationship between anxiety and AF and the role of anxiety in the development of AF. Therefore, this study was designed to determine whether a relationship exists between preoperative anxiety levels and the postoperative development of AF.

Methods

Research Design

This descriptive study was conducted on patients hospitalized in cardiovascular surgery units who were scheduled for CABG surgery between June 2018 and September 2018.

Sample

The study population included 334 patients who received CABG surgery between 2016 and 2017. On the basis of the calculations used in Lioni et al. (2014), the sample size was calculated using the power analysis method (G*Power 3.1). The difference between two independent means (effect size $|d| = 0.77$, power $= 0.9$) was referenced, and the minimum sample size was determined as 126 patients. Eleven patients who had intra-aortic balloon pumps, one patient who had a pacemaker, and one patient who lacked postoperative vigilance were excluded from the study. The inclusion criteria were being over 18 years old and able to communicate, having a planned surgery, being willing to participate in the study voluntarily, not having a psychiatric disease, being diagnosed with AF in the postoperative period, and starting to take related medication. Exclusion criteria were taking antianxiety or antidepressant medication preoperatively, having a psychiatric illness, undergoing an urgent surgery, having postoperative unconsciousness, having previous cardiac surgery, refusing to participate, and receiving a previous AF diagnosis or a diagnosis of AF during the routine electrocardiogram (ECG) in the preoperative period.

Approval (09/05/2018-2018/19) for this study was obtained from the ethics committee of Trabzon Kanuni Training and Research Hospital, and written permission was received from Trabzon Ahi Evren Chest and Cardiovascular Surgery Training and Research Hospital. The participants were informed of the purpose of the research, and their written consent was obtained. Participants could withdraw from the survey at any time without providing any justification.

Instruments

A patient information form and the State-Trait Anxiety Inventory were used to collect the data.

Patient information form

The patient information form was created by the researchers in two parts with 12 questions. The first part collects demographic information such as age, gender, marital status, educational status, smoking status, alcohol drinking status, comorbid disease status, and preoperative medication. The second part collects data on intubation time, mobilization time, compliance with respiratory physiotherapy, intensive care unit length of stay, use of inotropic agents, and development of AF.

State-Trait Anxiety Inventory

This inventory, developed by Spielberger et al., has two parts of 20 items each. There are two types of expressions in the scales, either direct or inverted. Direct expressions refer to negative emotions, and reversed expressions refer to positive feelings.

The first part of the inventory, the State Anxiety Inventory (SAI), was designed to assess how an individual feels at a certain moment and under certain conditions. The participants were asked to mark one of the options of (1) none, (2) a little, (3) quite, and (4) completely according to the severity of the current emotions regarding the items of the scale. There are 10 reversed expressions in the SAI (1st, 2nd, 5th, 8th, 10th, 11th, 15th, 16th, 19th, and 20th items).

The second part of the inventory, the Trait Anxiety Inventory (TAI), was designed to assess how an individual feels normally, regardless of external situations and circumstances. One of four options may be selected based on the frequency of feelings experienced, including (1) rarely, (2) sometimes, (3) often, and (4) almost always. There are seven reversed expressions (21st, 26th, 27th, 30th, 33rd, 36th, and 39th items) in the TAI.

For scoring, the total weights of the direct and reversed expressions are determined separately. The total weight score of the reversed statements is subtracted from the total weight score obtained for direct expressions. A predetermined and constant value is added to this number, equal to 50 for the SAI and 35 for the TAI, with the final score used as the respondent’s anxiety score. The total possible range of scores for both inventories is 20–80, with higher scores indicating higher levels of anxiety and lower scores indicating lower levels of anxiety. Validity and reliability were tested for the Turkish version of this instrument by Öner and Le Compte (1998). In the reliability analysis, Cronbach’s alpha internal consistency coefficient values were found to be .83–.87 for
the TAI and .94–.96 for the SAI. The retest reliability coefficients were determined to vary between .71 and .86 for the TAI and between .26 and .68 for the SAI (Karadag Arli, 2017). In this study, Cronbach’s alpha values were found to be .91 for the SAI and .74 for the TAI.

Data Collection

Patients were recruited from the target cardiovascular surgery units. The nurse researcher collected data from patients who met the sampling criteria. Those who agreed to participate were interviewed face-to-face by the same nurse researcher. The patient information form and the State-Trait Anxiety Inventory were filled out according to the answers given to the researcher by the participants. All of the participant responses were recorded in questionnaires.

ECG electrodes were attached to the participants while being taken to the intensive care unit after their operation, and continuous ECG monitoring was performed with standard D-II derivations with an LED monitor. Patients with arrhythmias or complaints of palpitations during the postoperative period on the monitor or during routine follow-up were reported to the doctor by the nurse. A standard six-lead ECG was taken and evaluated by the doctor. Cases in which no P wave in the ECG was detected and irregular electrical activity and R-R waves were detected were defined as AF by the doctor. In addition, the participants who did not return to sinus rhythm and/or did not have P waves over 1 hour despite receiving recommended interventions (potassium replacement, oxygenation, electrocardiography, x-ray evaluation for tamponade, etc.) before receiving amiodarone treatment were accepted as having AF. Afterward, an amiodarone treatment protocol was applied.

As a clinical protocol, when leaving the operating room, if the participant’s blood pressure was not excessively high, an inotropic agent was initiated. On the basis of hemodynamic criteria, it was decided on the first postoperative day whether to continue using an inotropic agent.

Data Analysis

The IBM SPSS Statistics Version 21 (IBM Inc., Armonk, NY, USA) software was used for statistical analysis. Descriptive statistics such as percentage, mean, and standard deviation were used to analyze demographic data as well as SAI and TAI scores. The relationships among AF and demographic variables, SAI scores, and TAI scores were analyzed using a chi-square test and an independent variables, SAI scores, and TAI scores were analyzed using a chi-square test. Logistic regression was applied to explain the relationships between the dependent variable and all of the significant independent variables. First, univariate logistic regression analysis was performed. On the basis of this result, multivariate models were established to explain the relationships between all of the significant independent variables (age, trait anxiety score, comorbid disease, and compliance with respiratory physiotherapy) and the dependent variable (AF development). A p value of less than .05 was accepted as statistically significant.

Results

In this study, 82.3% of the patients were male and 96.5% were married. The mean age was 65.5 years (SD = 10.4). Most (79.9%) did not smoke, 88.5% did not use alcohol, 70.8% had comorbid diseases (DM and/or HT), and 45.1% were determined to have taken preoperative medication (antiarrhythmic/beta-blocker). The SAI mean score in the preoperative period was 37.8 (SD = 9.2), and the TAI mean score was 37.6 (SD = 7.0).

The inotropic agent was used in 77.9% of patients in the postoperative period, the mean intubation time was 10.0 ± 4.0 hours, and 52.2% of patients complied with respiratory physiotherapy. The intensive care unit stay was 2 days for 62.8% of the participants, and postoperative mobilization time for 91.2% of the participants was 1 day. One quarter (26.5%) of the participants developed AF during the postoperative period (Table 1).

The mean age of the participants who developed AF was 69.16 years (SD = 6.69), which was statistically significant (p < .05). A history of comorbid disease (DM and/or HT) was indicated in 33.8% of the participants who developed AF, which was statistically significant (p < .05). In addition, 40.7% of the participants who developed AF were incompatible with respiratory physiotherapy, which was statistically significant (p < .05). Although AF developed in 25.5% of the participants who were using preoperative antiarrhythmic/beta-blockers, this difference was not statistically significant (p > .05; Table 2).

In this study, the mean SAI score was 39.8 ± 9.2 and the mean TAI score was 40.2 ± 7.8 in the participants with AF. Although no significant difference was found in the preoperative SAI scores of those participants who developed AF, their TAI scores were found to be significantly higher (p < .05; Table 3).

Results of Logistic Regression

The results of univariate logistic regression showed that the variables that had a statistically significant effect on the development of AF included TAI score, age, comorbid disease status, and respiratory physiotherapy compliance status (odds ratio [OR] = 1.08, p < .05, OR = 1.05, p < .05, OR = 5.09, p < .05; and OR = 4.38, p < .05, respectively). Having a higher TAI score, being older, having a comorbid disease, and noncompliance with respiratory physiotherapy each were shown to increase the risk of developing AF. Multivariate models were subsequently established based on these results. In the first model, both TAI scores and age were found to have a significant risk-increasing effect on the development of AF. TAI scores had a more significant effect than age (OR = 1.08, p < .05, and OR = 1.05, p < .05, respectively). In the second model, TAI scores, age, presence of comorbid disease, and compliance with respiratory physiotherapy were analyzed. It was observed that having a higher TAI score and noncompliance with respiratory physiotherapy each increased the risk of developing AF (OR = 1.07, p < .05, and OR = 3.70, p < .05, respectively).
respectively), with noncompliance with respiratory physiotherapy having a more significant effect than TAI score (Table 4).

Discussion

In this study, patients with high anxiety scores in the preoperative period were found to be at a significantly higher risk of developing AF in the postoperative period. AF is a common complication that arises after CABG surgery (Gill et al., 2014). As reported in the literature, the post-CABG surgery rate of AF development is between 15.2% and 19% (Atilgan et al., 2017; Folla et al., 2016). In this study, the rate was found to be 26.5%, which is similar to the literature. If the presence of valve replacements were considered, as in Dave et al. (2018), the rate of AF development (40.7%) may increase (Dave et al., 2018).

As emphasized in a systematic review study, there is not sufficient information yet to make a definitive determination regarding whether anxiety is a trigger of AF. Levels of anxiety in patients are generally high before heart surgery (Gomes & Bezerra, 2017; Hernández-Palazón et al., 2018; Ramesh et al., 2017). Anxiety may stem from uncertainty, lack of information about the surgery, and not knowing what to expect (Hernández-Palazón et al., 2018). A complex relationship exists between AF and anxiety (Patel et al., 2013). However, psychological stressors and imbalances in the autonomic nervous system are known to be triggers of paroxysmal AF (Maheswar & Ann, 2017). In this study, the preoperative state-trait anxiety scores of the participants were moderate, and postoperative AF developed in those participants with high preoperative trait anxiety scores. In addition, trait anxiety was identified in this study as a risk factor in the development of AF, with higher TAI scores associated with a higher risk of developing AF. Koleck et al. (2021) reported AF symptom severity to be associated with trait anxiety (Koleck et al., 2021). Polikandrioti et al. (2018) found high levels of anxiety in 34.9% of their patient population. Thompson et al. (2014) indicated that as patients’ anxiety levels increase, the severity of specific symptoms associated with AF increases. The findings of various studies support that anxiety increases the risk of developing AF again after ablation (Yu et al., 2012) and that anxiety levels are generally high in patients with AF (Evli & Curuk, 2017; Lioni et al., 2014). An increase in sympathetic nervous system activity and the release of catecholamines occur in anxiety disorders. Increased serum catecholamine levels trigger Takotsubo (or stress) cardiomyopathy through microvascular endothelial damage and the cardiotoxic effects of catecholamine. Susceptibility to AF may be partially related to anxiety disorders through the same catecholamine-mediated myocardial injury seen in stress cardiomyopathy. In anxiety disorders, catecholamine overload may lead to arrhythmogenic substrate formation and may be a trigger for the onset of paroxysmal AF (Severino et al., 2019). In stressful situations, the activation of the parasympathetic nervous system has also been observed. As a result, vagal stimulation shortens the duration of the atrial action potential. As vagal fibers in the atrium are irregular, an increase in vagal activity may result in significant differences in electrical activity in the

| Characteristic                          | n  | %  |
|----------------------------------------|----|----|
| Age (years; mean and SD)               | 65.5 | 10.4 |
| Gender                                 |    |    |
| Female                                 | 20  | 17.7|
| Male                                   | 93  | 82.3|
| Marital status                         |    |    |
| Married                                | 109 | 96.5|
| Single                                 | 4   | 3.5 |
| Educational level                      |    |    |
| Illiterate                             | 12  | 10.6|
| Primary + secondary school             | 71  | 62.8|
| High school or above                   | 30  | 26.6|
| Cigarette smoking                      |    |    |
| Yes                                    | 34  | 30.1|
| No                                     | 79  | 79.9|
| Alcohol use                            |    |    |
| Yes                                    | 13  | 11.5|
| No                                     | 100 | 88.5|
| Comorbid disease status a              |    |    |
| Yes                                    | 80  | 70.8|
| No                                     | 33  | 29.2|
| Preoperative medication                |    |    |
| (antiarrhythmic/beta-blocker)          |    |    |
| Yes                                    | 51  | 45.1|
| No                                     | 62  | 54.9|
| Use of inotropic agent                 |    |    |
| Yes                                    | 88  | 77.9|
| No                                     | 25  | 22.1|
| Compliance with respiratory physiotherapy |    |    |
| Yes                                    | 59  | 52.2|
| No                                     | 54  | 47.8|
| Intubation time (mean and SD)          | 10.0 | 4.0 |
| Intensive care unit stay               |    |    |
| 2 days                                 | 71  | 62.8|
| 3 days and over                        | 42  | 37.2|
| Mobilization time                      |    |    |
| 1 day                                  | 103 | 91.2|
| 2 days and over                        | 10  | 8.8 |
| Development of atrial fibrillation     |    |    |
| Yes                                    | 30  | 26.5|
| No                                     | 83  | 73.5|
| State Anxiety Inventory (mean and SD)  | 37.8 | 9.2 |
| Trait Anxiety Inventory (mean and SD)  | 37.6 | 7.0 |

a Diabetes mellitus and/or hypertension.
atrium, which is associated with increased sensitivity to reentry and the development of AF (Podrid & Kowey, 2001). Chronic stress and anxiety may further increase the likelihood of developing AF because of various conditions that modulate the autonomic nervous system, modify the atrial substrate, and trigger the mechanism at different levels (Severino et al., 2019).

Many factors have been identified as contributing to AF development after CABG surgery (Atilgan et al., 2017), including advanced age, as the frequency of AF development increases with age (Fumagalli et al., 2015; Omer et al., 2016). In this study, a significant relationship was found between age and the development of AF, with the risk of developing AF rising with age. Similar to this study, other studies have identified a relationship between advanced age and AF development (Atilgan et al., 2017; Folla et al., 2016; Fumagalli et al., 2015). The findings of this study revealed a statistically significant difference between those with and without a comorbid disease such as DM and/or HT in terms of the postoperative AF development rate. The results of the logistic regression analysis in this study highlighted that the presence of a comorbid disease increased the risk of developing AF in the univariate model. However, in the second multivariate model, it was observed that the presence of comorbid disease did not affect

Table 2

| Characteristic | AF Developed (n = 30) | AF Not Developed (n = 83) | t/χ² | p |
|---------------|----------------------|--------------------------|------|---|
| Age (years; mean and SD) | 69.16 6.69 | 64.24 11.24 | t = 2.256 | .026* |
| Gender | | | | |
| Female | 8 40.0 | 12 60.0 | | .92 |
| Male | 22 23.7 | 71 76.3 | | .130 |
| Cigarette smoking | | | | |
| Yes | 5 14.7 | 29 85.3 | | .061 |
| No | 25 31.6 | 54 68.4 | | .061 |
| Comorbid disease status | | | | |
| Yes | 27 33.7 | 53 66.3 | t = 7.285 | .007* |
| No | 3 9.1 | 30 90.9 | | |
| Preoperative medication (antiarrhythmic/beta-blocker) | | | | |
| Yes | 13 25.5 | 38 74.5 | | .817 |
| No | 17 27.4 | 45 72.6 | | .817 |
| Use of inotropic agent | | | | |
| Yes | 24 27.3 | 64 72.7 | | .744 |
| No | 6 24.0 | 19 76.0 | | .744 |
| Compliance with respiratory physiotherapy | | | | |
| Yes | 18 13.6 | 51 86.4 | t = 10.62 | .001* |
| No | 22 40.7 | 32 59.3 | | |
| Intensive care unit stay | | | | |
| 2 days | 16 22.5 | 55 77.5 | | .209 |
| 3 days and over | 14 33.3 | 28 66.7 | | |
| Mobilization time | | | | |
| 1 day | 28 27.2 | 75 72.8 | | .623 |
| 2 days and over | 2 20.0 | 8 80.0 | | |
| Intubation time (hours; mean and SD) | | | | |
| 10.23 4.44 | 9.92 3.91 | t = 0.353 | .725 |

* Diabetes mellitus and/or hypertension.
* p < .05.

Table 3

| Anxiety Score | AF Developed | AF Not Developed | p |
|---------------|--------------|------------------|---|
| Mean | SD | Mean | SD | |
| State Anxiety Inventory | 39.8 9.2 | 37.1 9.1 | .18 |
| Trait Anxiety Inventory | 40.2 7.8 | 36.6 6.3 | .02* |

* p < .05.
the risk of developing AF. Ismail et al. (2017) determined that DM influenced postoperative AF development, and Karakaş (2018) and Son et al. (2016) found that the rate of AF development is higher in patients with HT. However, the findings of some studies have emphasized that comorbid diseases such as HT and DM do not influence the development of AF (Atilgan et al., 2017; Folla et al., 2016; Omer et al., 2016).

In this study, although the rate of AF development was low in the participants who used preoperative beta-blockers/antiarrhythmics, this difference was not statistically significant. Tsai et al. (2015) reported that beta-blocker therapy reduced the risk of developing postoperative AF.

The development of AF was lower in patients who complied with postoperative respiratory physiotherapy compared with those who did not in this study. In addition, incompatibility with respiratory physiotherapy was found to be a risk factor in the development of AF and to increase the likelihood of AF development. Respiratory rehabilitation techniques such as respiratory physiotherapy, deep breathing exercise, chest physiotherapy, continuous positive airway pressure, and noninvasive positive pressure ventilation (NPPV) are widely applied to reduce complications and improve recovery after heart surgery (Shakuri et al., 2014; Tashiro et al., 2015; Westerdahl, 2015). In the literature, many studies have shown that continuous positive airway pressure helps maintain sinus rhythm in patients with AF. However, these studies were mainly conducted on patients with AF who have obstructive sleep apnea (Linz et al., 2018). Respiratory support may improve cardiac conditions that have been associated with a higher incidence of postoperative AF. A reduction in the incidence of AF development has been shown in cases in which adaptive servo-ventilation is used as a new version of NPPV. NPPV is widely used in cardiopulmonary rehabilitation (Tashiro et al., 2015). Cardiopulmonary rehabilitation may be an effective method to reduce the risk of AF development and time of arrhythmia in patients with paroxysmal and persistent AF (Robaye et al., 2020; Tashiro et al., 2015).

**Limitations**

This study was affected by several limitations. Data collection was carried out in a single medical center and on a relatively small sample of patients. During the study, as only the on-pump technique was used in patients with heart surgery, data were only collected from patients who received this technique. No surgery was performed using the off-pump technique during the study period. Another limitation of this study was that parameters such as cardiopulmonary bypass...
time, cross-clamp time, and number of grafts were not examined. Furthermore, as this study was designed only to evaluate the relationship between anxiety level in the preoperative period and the development of AF, postoperative anxiety was not assessed. Finally, the high rate of inotropic agent use by the participants in our study is a limitation, as inotropic agents have been associated with an increased risk of AF development.

Conclusions
The results of this study support that trait anxiety increases the risk of developing AF and that having a higher level of preoperative anxiety may promote the development of AF after CABG surgery. In addition, age, comorbid disease, and noncompliance with postoperative respiratory physiotherapy were identified as factors associated with the development of AF. Logistic regression analysis revealed that age, comorbid disease status, compliance with postoperative respiratory physiotherapy, and trait anxiety score may be risk factors for the development of AF.

Implications for Clinical Practice
In addition to taking anamnesis from patients who will have CABG surgery, anxiety levels of patients should also be measured. Therefore, using a tool to routinely measure the anxiety levels of patients in cardiovascular surgery units is recommended. Furthermore, using a tool to routinely measure the anxiety levels of patients in cardiovascular surgery units may be recommended to reduce the incidence and severity of postoperative AF. Further studies should be conducted to explore the factors associated with the development of AF after CABG surgery.

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Author Contributions
Study conception and design: All authors
Data collection: SAK, EG
Data analysis and interpretation: SAK, EG, MOH
Drafting of the article: All authors
Critical revision of the article: SAK, MOH

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