

Results of Coronary Artery Bypass Grafting Surgery in Female Smokers and Female Patients who make Tandoori who had Chronic Obstructive Pulmonary Disease

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ABSTRACT

Among the risk factors for coronary artery disease, the most important is smoking. Another major risk factor for coronary artery disease is the smoke from tandoor ovens, to which many rural women are exposed over a period of years.

Of 856 patients who underwent elective CABG surgery in our clinic between January 2011 and January 2017, 345 female patients were investigated retrospectively.

The patients were divided into two groups: Group 1 (smokers, n=47) and Group 2 (tandoor bakers, n=91). The mean age was 59.4 ± 5.2 years for Group 1 and 62.3 ± 4.2 years in Group 2. The mean duration of extubation of the patients in intensive care unit was 5.4 ± 2.1 in Group 1, and 8.2 ± 2.4 hours in Group 2 (p < 0.001). The average length of stay in the intensive care unit was 2.1 ± 1.5 days for Group 1 and 4.4 ± 2.2 days for Group 2 (p < .05).

Chronic obstructive pulmonary disease is an independent risk factor for CABG. Aside from smoking, which frequently results in COPD, pulmonary functions are exacerbated in people (usually women) who bake using tandoor ovens. In these patients, the duration of postoperative intubation, length of stay in the intensive care unit and in the hospital are extended, and the need for Continuous Positive Airway Pressure (CPAP) machines in the intensive care unit increases. Therefore, women who use tandoor ovens should be considered high risk patients for CABG surgery, and these patients should be managed and followed up with caution.

Key Words: Coronary Artery Disease, Tandoor Exposure, COPD

Introduction

Although chronic obstructive pulmonary disease (COPD) can develop due to smoking, it may also occur as a result of factors such as occupational exposure to dust (as experienced by mine workers), air pollution, asthma, bronchitis, and genetic susceptibility (1). In the pathophysiology of COPD, there is an increased chronic inflammatory response of airways and lung tissue against harmful gases and particles. Generally defined as an airway obstruction, COPD is specifically described as a prolonged expiratory phase (2). The number of deaths annually due to COPD is approximately 2.9 million people worldwide, and this number is increasing both in Turkey and on a global scale (3). With early diagnosis and the cessation of smoking, its progression can be halted and the prognosis is good (4). The most

common symptoms of COPD that negatively affect the quality of life are shortness of breath, chronic cough, and the production of sputum (5).

The spirometry test is necessary for a diagnosis of COPD. It is calculated by measuring the forced vital capacity (FVC) in the spirometer and the volume of air expired in one second (FEV1). If the FEV1/FVC ratio is below 70% after the administration of bronchodilator agents during the procedure, a diagnosis of COPD is made (6). The cardiothoracic ratio/rate increases overgrown with lung size, as evidenced in lung imaging. As a result of hyperaeration, the flattening of the diaphragm domes, decreased heart size, and/or tightening of the peripheral vascular structures of the lungs may be observed (7).

Conservative treatment may be indicated and emergency intervention may be necessary especially

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Fig. 1. Women making bread in tandoor

during winter months, a period known for COPD exacerbation, as this is a life-threatening condition. COPD is frequently associated with numerous comorbidities, and its mortality rate increases with the presence of comorbid factors. Comorbidities associated with COPD include cardiovascular diseases, metabolic diseases, obesity, hypertension, and diabetes mellitus (8). COPD is closely associated with smoking and thus often co-occurs with other comorbidities associated with smoking. The most common comorbid factor is ischemic heart disease (9).

The use of tandoor ovens for baking bread is still common in villages throughout eastern Turkey. The smoke from such ovens, which contains dense biomass, differs from that of cigarettes and penetrates the lungs more intensively, with its ash and large particles, than cigarette smoke (10). Figure 1 shows the smoke and the ash layer found in the village of the women tandoor bakers. Images of their lungs have the appearance of partially frosted glass.

In this study, we aimed to examine the latter effects of CABG surgery in female COPD patients who smoke and in their non-smoking cohorts who bake using tandoor ovens.

Materials and Methods

The study protocol was approved by the Ethics Committee of the Rectorate of Yüzüncü Yıl University (Decision No: 10) on 07 December 2018. The study was conducted in accordance with the principles of the Helsinki Declaration. The case histories of 345 women, out of a total of 856 patients who underwent elective surgery in our clinic between January 2011 and January 2017, were analyzed retrospectively. Of these 345 female patients, 138 had been diagnosed with chronic obstructive pulmonary disease (COPD). These patients were divided into the

following two groups: Group 1 (smokers, $n = 47$) and Group 2 (tandoor bakers, $n = 91$). All patients underwent isolated coronary bypass surgery. Patients who had undergone additional surgeries, such as aortic surgery, valve surgery, or emergency surgery, and patients with low cardiac output rates were excluded from the study. Preoperative data for all patients, including the existence of comorbidities such as diabetes mellitus (DM), hypertension (HT), and hypercholesterolemia, as well as the use of antiaggregants, were recorded in detail (Table 1). EuroSCORE was used to calculate the preoperative risk score for patients. Median sternotomy was performed on all patients after removing the patient from the ventilator, to avoid opening the right hemithorax. The left hemithorax was then opened and left internal mammary artery (LIMA) was prepared, along with saphenous vein graft (SVG). After heparinization, medication was administered such that the activated clotting time (ACT) was set over 460 for the cardiopulmonary bypass and all patients underwent CABG surgery. The number of distal anastomoses, duration of CPB, cross-clamp time, the use of inotropic agents, and blood and blood products used in the operation were all recorded and statistically evaluated.

The patients were extubated post-operatively in the intensive care unit. Intubation times, bleeding amounts, revision rates, atrial fibrillation rates, reintubation rates, and mortality rates were examined in details and statistically analyzed.

Statistical Analysis: Statistical analyses were performed using SPSS (Statistical Package for Social Sciences, Chicago, IL, USA) version 24.0. Descriptive statistical methods (frequency, percentage, mean, and standard deviation) were used to evaluate the study data. For comparison of the parameters between groups, the Mann-Whitney U test was employed. The Wilcoxon signed-rank test was used for intergroup comparisons of FEV1/FVC, reintubation rates, and intubation time values. The results were evaluated at a confidence interval of 95%, with significance level $p < .05$.

Results

The patients were divided into two groups: Group 1 (smokers, $n=47$) and Group 2 (tandoor bakers, $n=91$). The mean age was 59.4 ± 5.2 years for Group 1 and 62.3 ± 4.2 years for Group 2. All 138 female patients had been diagnosed with COPD. The average time from diagnosis to operation was 4.2 ± 1.3 years for Group 1 and 6.6 ± 2.3 years for Group 2. There was no statistically significant difference between the two groups in terms of hypertension,

Table 1. Preoperative Patient Data

Variable	Total (n=138)	Group 1 (n=47)	Group 2 (n=91)	p value
Mean Age (years)	61.3 ± 4.6	59.4 ± 5.2	62.3 ± 4.2	0.724
Mean BMI(kg/m ²)	24.8 ± 3.10	23.5 ± 2.41	25.1 ± 1.9	0.656
COPD diagnosis Time (year)	5.1 ± 1.8	4.2 ± 1.3	6.6 ± 2.3	0.227
FEV1/FVC	61 ± 6	62 ± 7	59 ± 8	0.189
Levels of oxygen-free saturation (%)	84 ± 4	89 ± 5	81 ± 3	0.545
Pulmonary Artery Pressure (mmHg)	32.4 ± 10.6	29.4 ± 11.4	39.3 ± 9.6	<0.001*
Mean EF (%)	45 ± 2.5	44 ± 4.4	47 ± 3.8	0.634
Use of acetylsalicylic acid n (%)	95 (% 68.8)	36 (% 76.5)	59 (% 64.8)	0.913
Hypertension n (%)	85 (% 61.5)	28 (% 59.5)	57 (% 62.6)	0.753
Level of Preoperative Hg (gr/dl)	15 ± 2.3	16 ± 1.4	15 ± 2.4	0.565
Level of Preoperative Platelet Amount	205.000 ± 20.500	195.000 ± 30.000	215.000 ± 20.000	0.667
NYHA Functional Class (1-5)	3.80 ± 0.9	2.8 ± 0.7	3.84 ± 0.9	0.674
EUROSCORE	3.5 ± 1.5	3.2 ± 2.4	3.6 ± 2.5	0.459

For statistical analyses Mann-Whitney U test and The Wilcoxon signed-rank test were used

Values are n (%) for categorical variables and mean ± standard deviation for continuous variables

Abbreviations:

FEV1/FVC: Force Expiratory Volume 1/Force Vital Capacity

EF: Ejection Fraction

BMI: Body Mass Index

NYHA: New York Heart Association

Table 2. Operation Data

Variable	Total (n=138)	Group 1 (n=47)	Group 2 (n=91)	p value
Number of Anastomoses	2.45 ± 1.6	2.2 ± 1.5	2.6 ± 1.7	0.641
Total Bypass Duration (minutes)	88.2 ± 15.3	88.5 ± 13.6	90.4 ± 14.9	0.503
Aortic Cross Clamp Duration (minutes)	55.1 ± 12.2	52.7 ± 13.6	61.7 ± 16.8	0.465
Amount of Blood Product Used During Operation (units)	1.1 ± 1.0	1.1 ± 1.2	1.2 ± 0.9	0.574

Values are n (%) for categorical variables and mean ± SD for continuous variables

hypercholesterolemia and peripheral artery disease. Both groups of patients were under treatment with bronchodilator therapy. A total of 25 patients (53.1%) from Group 1 patients and 56 patients (61.5%) from Group 2 received steroid treatment. Mean values for preoperative FEV1/FVC were 62 ± 7 for Group 1 and 59 ± 8 for Group 2 ($p=.189$). Mean oxygen-free saturation values were 89 ± 5 for Group 1 and 81 ± 3 for Group 2 ($p=.545$). The mean pulmonary artery pressures were 29.4 ± 11.4 for Group 1 and 39.3 ± 9.6 mm Hg for Group 2 ($p < .001$). Mean Ejection Fraction (EF) was 44 ± 4.4 for Group 1 and 47 ± 3.8 for Group 2 ($p=.634$). The mean duration of aortic cross-clamp (ACC) during the CPB surgery was 52.7

± 13.6 minutes for Group 1 and 61.7 ± 16.8 minutes for Group 2 ($p=.465$). The mean number of distal anastomoses was 2.2 ± 1.5 for Group 1 and 2.6 ± 1.7 for Group 2 ($p=.641$). During the surgery, an average of 1.1 ± 1.2 U of blood products was used in Group 1 and 1.2 ± 0.9 U in Group 2 ($p=.574$). Data pertaining to the patients' operations are presented in Table 2.

The mean duration of extubation of the patients in intensive care unit was 5.4 ± 2.1 in Group 1 and 8.2 ± 2.4 hours in Group 2 ($p < 0.001$), patients who had reentubation in intensive care unit were 3 (6.3%) in Group 1 and 9 (9.8%) in Group 2. Patients who had CPAP application in intensive care unit were 8 patients

Table 3. Postoperative Patient Data

Variable	Total (n=138)	Group 1 (n=47)	Group 2 (n=91)	p value
Total Drainage	850 ± 120	845 ± 160	920 ± 150	0.868
Total Blood Transfusion (unit)	1.2 ± 0.5	1.1 ± 0.8	1.0 ± 0.4	0.064
Hemoglobin	9.8 ± 1.1	10.6 ± 2.2	8.5 ± 1.1	0.072
Revision surgery rate in the first 48 Hours Due to Bleeding	2 (% 1.4)	1 (% 2.1)	1 (% 1.09)	0.067
Pleural effusion	5 (% 3.6)	2 (% 4.2)	3 (% 3.2)	0.581
Platelet Count	145.000±30.000	180.000 ± 20.000	110.000 ± 28.000	0.964
Intubation Duration (hours)	6.5 ± 4.5	5.4 ± 2.1	8.2 ± 2.4	<0.001*
Reintubation n (%)	12 (% 8.6)	3 (% 6.3)	9 (% 9.8)	<0.001*
Postoperative AF n (%)	39 (% 28.2)	11 (% 23.4)	28 (% 30.7)	<0.001*
Duration in Intensive Care (days)	3.5 ± 1.8	2.1 ± 1.5	4.4 ± 2.2	<0.001*
CPAP application	34 (%24.6)	8 (%17)	26 (%28.5)	<0.001*
Total Hospital Stay (days)	13.2 ± 3.5	10.4 ± 2.5	14.6 ± 2.2	<0.001*
Mean Removal of the drains (days)	2.01 ± 1.4	2.0 ± 1.1	2.1 ± 0.6	0.687
Mortality	4 (% 2.8)	2 (% 4.2)	2 (%2.1)	0.657

Values are n (%) for categorical variables and mean ± SD for continuous variables

(17%) in Group 1 and 26 (28.5%) patients in Group 2 ($p < 0.001$). Postoperative atrial fibrillation (AF) in 11 (23.4%) in Group 1, 28 (30.7%) patients in Group 2 and were statistically significant ($p < 0.001$). Mean duration of hospital stay was 2.1 ± 1.5 days in Group 1 and 4.4 ± 2.2 days in Group 2 ($p < 0.001$). The mean length of hospital stay was 10.4 ± 2.5 days in Group 1 and 14.6 ± 2.2 days in Group 2 ($p < 0.001$). The postoperative data of the patients were given in Table 3. Patients who entered AF were returned to sinus rhythm with amiodarone and metoprolol treatment. Four patients (Group 1 (4.2%) and Group 2 (2.1%) patients) had mortality in all patients ($p = 0.657$). The main cause of mortality was pulmonary infection and sepsis due to prolonged intubation.

Discussion

Tandoor culture, which dates back to prehistoric times, continues today in rural areas of eastern Turkey. The tandoor oven, which in earlier times was used to cook both food and bread, is today only used for baking bread recently (11). Usually constructed using clay soil, tandoor ovens are approximately 0.5 m in diameter and 1.5 m high, with an opening, and are buried underground. A fire burns at the bottom, and dough is stuck to the upper part of the oven or placed on a pan placed inserted into the oven through the opening.

Much as there are differences in living conditions among developing and less-developed countries, cooking methods and techniques also vary. Particularly in less-developed countries, food and bread making is performed in tandoor ovens located either inside the house or outside of the house. Although there are differences according to region in what these tandoors, which essentially have a closed environment, use for fuel, there are some that burn animal wastes (dried dung), while others burn materials such as wood and straw (12). Compared with tandoor ovens that burn wood, the smoke and particles released by those using dried dung for fuel are more intense and irritating. Due to economic conditions in the villages of eastern Turkey, village women still bake their bread in tandoor ovens (13).

According to a study conducted in 2010, ischemic heart disease is the leading cause of death in the world, followed by cerebrovascular diseases, COPD, lower respiratory tract infections, and lung diseases in second, third, fourth, and fifth places, respectively (14). This ranking is especially indicative of living standards in both developed and developing countries.

In countries such as India, where most of the populations resides in the countryside, people still make bread by burning wood and dried dung due to inadequate economic conditions. Arora et al. (15) reported that women in India who cooked food in

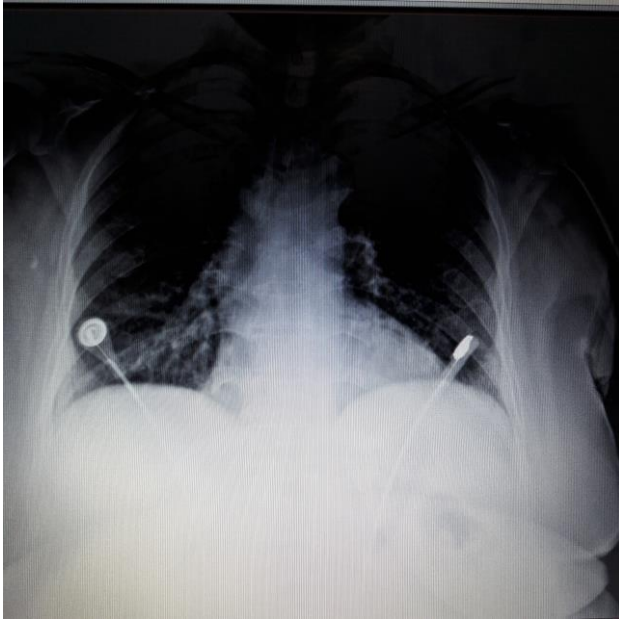


Fig. 2. Lungs have the appearance of partially frosted glass

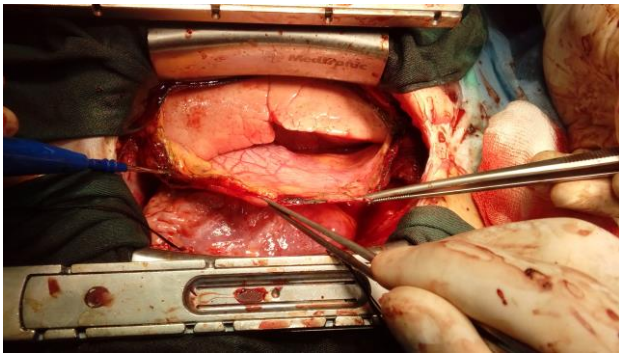


Fig. 3. Macroscopic image with normally lung

ovens using animal waste or wood for fuel had impaired respiratory function, and the patients were diagnosed with COPD.

The severity of the negative effects of smoke exposure differs according to the conditions in which exposure occurs, for example smoke encountered open areas versus closed areas. Hu et al. (16) observed a deterioration of pulmonary function in those who make bread in closed spaces rather than those who baked in open spaces.

Genetic factors have been shown to play a role in the pathophysiology of COPD. Hardin et al. (17) reported that genetic factors were detected in patients with COPD and asthma. Following a meta-analysis, GPR65, CSMD1, and SOX5 gene polymorphisms were detected.

Smoking is the primary risk factor in the development of COPD (18). Data on COPD in general population indicated that it is closely associated with both excessive smoking and an increasing number of elderly people (19). Although there has been no definite study on the smoking rates of women in our

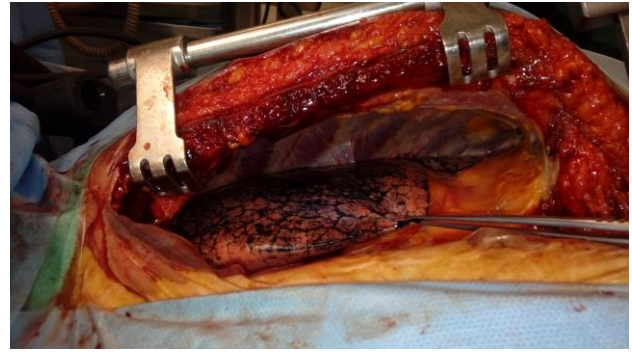


Fig. 4. Macroscopic lung view of a smoker patients

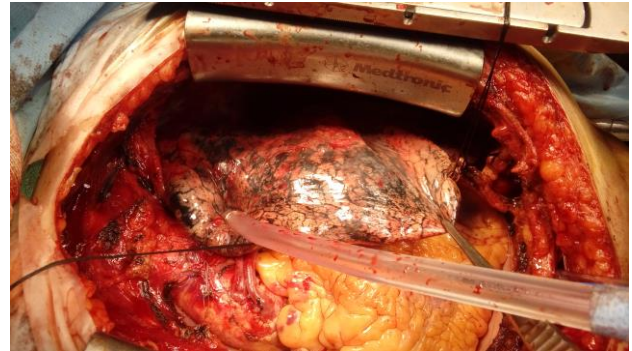


Fig. 5. Macroscopic lung appearance of the patient who makes tandoor

region (eastern Turkey), approximately 85% of males and 15% of females undergoing heart surgery in our clinic reported smoking.

Smoking is considered to be a scientifically proven and preventable risk factor in the development of atherosclerosis (20). It is one of the main causes of coronary artery disease, especially when accompanied by elevated blood pressure and lipid profile disorder. Major complications of atherosclerosis are coronary artery disease, aortic aneurysms, peripheral vascular diseases and cerebrovascular diseases (7).

In a study conducted by Njolstad et al. (21), 11,843 patients were examined and followed up for a period of 12 years. The risk assessment for smoking was calculated according to rates of myocardial infarction, arterial blood pressure, gender, and mortality. As a result, smoking was determined to be an independent risk factor for myocardial infarction, regardless of gender.

Atrial fibrillation (AF) occurs at a rate of 30% following cardiac surgery, and is the most common cardiac rhythm disorder. A number of factors may play a role in the development of AF. During and following surgery, many factors such as blood and blood product use (22), infection, advanced age, obesity, low oxygen level, long operation time, prolonged intubation time and elevated C-reactive protein (CRP) have been associated (23). Some studies have suggested that the incidence of atrial fibrillation following cardiac surgery is higher in

smokers than in non-smoking patients. In a meta-analysis of 626,603 patients by Wong et al. (24), 51 studies were examined. The meta-analysis found that atrial fibrillation rates following cardiac surgery were higher in smokers and obese patients. Mortality and morbidity were shown to increase with smoking together with other risk factors.

Pneumoconiosis in coal miners also appears with the same effects. COPD is known to be caused by the blockage of airways with particles. While this situation caused widespread suffering and illness among mine workers prior to the 1970s, as a result of research conducted in the 1980s and beyond, the prevalence of lung diseases such as COPD was reduced by decreasing the particle count from 6 mg/m³ to 2 mg/m³ (25). The aim is to reduce this amount to 1 mg/m³, which is the ideal level, by taking protective measures (26). It is also possible to protect women tandoor bakers living in rural areas from diseases that negatively impact the quality of life, such as COPD and heart disease, by taking protective measures similar to those that benefitted mine workers. Blackley et al. (27) reported that diseases such as COPD, pneumoconiosis, and progressive massive fibrosis can be reduced in coal miners.

In this study, COPD findings were present on chest imaging of women who smoked and non-smoking tandoor bakers, and on the lung radiographs of the latter group the appearance of frosted glass was widespread (Figure 2). The appearance of the lungs of the same patients differed during the operations. While the lungs of women who smoked appeared dark black and matte, those of the tandoor bakers were more blurred (Figure 3, Figure 4, Figure 5).

In patients with COPD, CABG surgery increases the risk rate independently. Compared to COPD caused by smoking, pulmonary functions are worse in female tandoor bakers. The duration of intubation is prolonged post-operatively, as is the length of stay in the intensive care unit and the need for CPAP while there, and the overall period of hospitalization is extended. For these reasons, CABG surgery in female tandoor bakers should be accepted as high risk and follow-up care should be conducted attentively, with full awareness of the accompanying risks.

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