







Clinical characteristics of patients undergoing coronary artery bypass surgery: Focus on gender differences

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ABSTRACT

Background and Aims: The aim of the present study is to investigate whether the clinical characteristics of patients undergoing coronary artery bypass surgery (CABG) differ by sex.

Methods: This study was performed with a total of 58 patients who underwent CABG. The age, weight, height, systolic and diastolic blood pressure, HbA1c, high-density lipoprotein (HDL), low-density lipoprotein (LDL) and total cholesterol values together with the demographic characteristics of patients undergoing CABG were collected and compared between male and female patients.

Results: In the present study, 71% of patients undergoing CABG were men and 29% of them were women. There was no significant difference in weight, systolic and diastolic blood pressure, HbA1c, and total cholesterol values between male and female patients. Body mass index, LDL and HDL levels, the ratios of LDL/total cholesterol and HDL/total cholesterol were higher while height was lower in females compared to male patients.

Conclusion: Our study highlights the need for sex-specific approaches in the prevention of coronary artery diseases. Risk factors including obesity, diabetes, hypertension, and dyslipidemia influence the outcome of death in patients undergoing CABG. Correct management of controllable risk factors with the focus on gender differences could be beneficial in reducing mortality and morbidity rates by altering the prognosis of coronary artery diseases.

Keywords: Coronary artery bypass surgery, patient characteristics, gender differences, cardiovascular risk factors

INTRODUCTION

Cardiovascular diseases are the most common cause of death globally and are the major contributor to the burden of premature mortality and morbidity. According to the WHO, cardiovascular diseases are responsible for approximately 17.9 million deaths every year (World Health Organization, 2017, https://www.who.int/health-topics/cardiovascular-diseases/#tab=tab_1). More than 75% of these deaths occur in low or middle income countries (Roth et al., 2017).

Among cardiovascular diseases, coronary artery disease (CAD), occurs primarily as a result of atherosclerosis of coronary arteries where plaque builds up inside them. Generally, patients with CAD are classified into two types according to their symptoms

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(Cowell, Newby, & Boon, 2004; Quertermous & Ingelsson, 2016). The first type is patients with chronic stable angina characterized by myocardial ischemia, which develops as a result of an imbalance between the oxygen demand of myocardium and the oxygen supply, and is often accompanied by chest pain (Kabakçı et al., 1990). The second type is acute coronary syndrome which is also known as acute myocardial infarction (MI) and unstable angina (Cowell et al., 2004), where a plaque rupture, plaque erosion and coronary thrombosis may develop and sudden coronary death may occur (Otsuka et al., 2015). The severity of CAD and treatment options are determined by the type and number of coronary arteries where stenosis occurs. Pharmacological therapy in the treatment of CAD is applied in order to reduce myocardial oxygen demand and increase myocardial blood flow to the heart. This treatment is carried out with various agents including nitrates, beta-blockers, angiotensin converting enzyme inhibitors, antiplatelets, and anticoagulation agents (Willerson & Helmes, 2015). Coronary revascularization is another frequently preferred safe and effective treatment method that improves myocardial perfusion and relieves myocardial ischemia symptoms (Wilson, 2015). Percutaneous coronary intervention (PCI) or coronary angioplasty is a widely used invasive treatment (Madhavan, Gersh & Alexander, 2018). In severe cases where patients are not responding to other pharmacological treatment methods, a coronary artery bypass graft operation (CABG) represents a superior surgical intervention for myocardial revascularization (Samak et al., 2016).

CABG is an important surgical procedure that improves blood flow to the heart by using venous or arterial grafts to bypass the part of the coronary artery where occlusion due to atherosclerosis occurs (Jannati, Navaei, & Ronizi, 2019). The CABG is known to be one of the most common surgical procedures worldwide with approximately 400,000 CABGs performed annually in the United States (Alexander & Smith, 2016). The success of a CABG depends on the long-term patency of venous or arterial grafts (Goldman et al., 2004). However, surgical trends have decreased as the use of alternative options such as medical treatment and PCI have increased (Bachar & Manna, 2020).

Hypertension, dyslipidemia, diabetes, kidney dysfunction, age, gender, lifestyle, cigarette smoking, diet, obesity, and family history have been found to be common risk factors for CAD in patients. Controlling these risk factors through lifestyle changes and, when necessary, through medical treatment can help to prevent CAD (Madhavan et al., 2018; Shao, Wang & Tian, 2020). Development of CAD in women when they are younger occurs less than in men because of the protective effects of oestrogen. A long-term follow up study indicated that high levels of total cholesterol and low-density lipoprotein (LDL), as well as diabetes eliminate the female advantage (Koch, Khandwala & Nussmeier, 2003; Bonow, Smaha & Smith 2002; Kannel & Wilson, 1995). Furthermore, in the post-menopausal period, the same frequency of CAD was detected for both genders (Ahmad et al., 2010).

Several studies have indicated that female gender is an independent predictor of poor post-operative outcome after CABG and this could be due to differences in clinical characteristics between female and male patients (Nicolini et al., 2016; Em-

mert et al., 2010; Bukkapatnam, Yeo & Li, 2010). In the present study, age, weight, height, systolic and diastolic blood pressure, HbA1c (glycated haemoglobin), high-density lipoprotein (HDL), LDL, and total cholesterol values together with the demographic characteristics of patients undergoing CABG were collected and compared between male and female patients.

MATERIALS AND METHODS

Subjects

This study was performed with a total of 58 patients who underwent CABG in Bakirkoy Dr Sadi Konuk Education and Research Hospital between November 2018 and August 2019. Personal information and the pre-operative worksheet were used to obtain patients' clinical characteristics. Subjects in all age groups who underwent CABG surgery were included in the study. Exclusion criteria were as follows: Previous cardiac surgery (open), aortic and mitral disease, concomitant procedures (e.g., aortic annulus enlargement, ascending aorta replacement, more than single-valve surgery) and tricuspid annuloplasty. Patient's gender, age, weight, height, systolic and diastolic blood pressure, HbA1c, HDL, LDL and total cholesterol values together with their demographic characteristics were collected and recorded. The study was approved by the Institutional Review Board of Istanbul University, Institute of Cardiology (no: İ.Ü.E.50.0.05.00/8). Patients enrolled in this study gave informed consent for all investigations.

Statistical analysis

The patients' age, weight, height, systolic and diastolic blood pressure, HbA1c, HDL, LDL and total cholesterol values were expressed in terms of their mean \pm standard error of mean (SEM). Body mass index (BMI) was calculated by dividing weight in kg by height in meter squared. Statistical analysis was performed using the Student's t-test. P value <0.05 indicated that data is significantly different. The statistical analysis was performed by using Graph Pad (Prism 7) software.

RESULTS AND DISCUSSION

Increased rates of in-hospital morbidity after CABG were observed in women (Koch et al., 2003). Furthermore, a meta analysis study including 966,492 patients reported that women had an increased risk for short-term, mid-term and long-term mortality compared with men undergoing CABG (Alam et al., 2013). This could be due to an unfavorable preoperative risk profile in women. In order to investigate this hypothesis, in the present study we compared several risk factors for CAD between women and men undergoing CABG in Turkey.

In the present study, 71% of the patients undergoing CABG were men and 29% of them were women. In accordance with our results, several studies indicated that the majority of patients who had undergone CABG were males (Ahmad et al., 2010; Koch et al., 2003; Varma et al., 2014; Elbardissi et al., 2012; Seccareccia et al., 2006; Dinh et al., 2008; McNeely, Markwell, & Vassileva, 2016). Our study demonstrated that the mean age was 61 years for both men (61 ± 1.96) and women (61 ± 1.38). The age distribution of both genders is presented in Figure 1. The majority (47%) of women were between 60-70 years-old

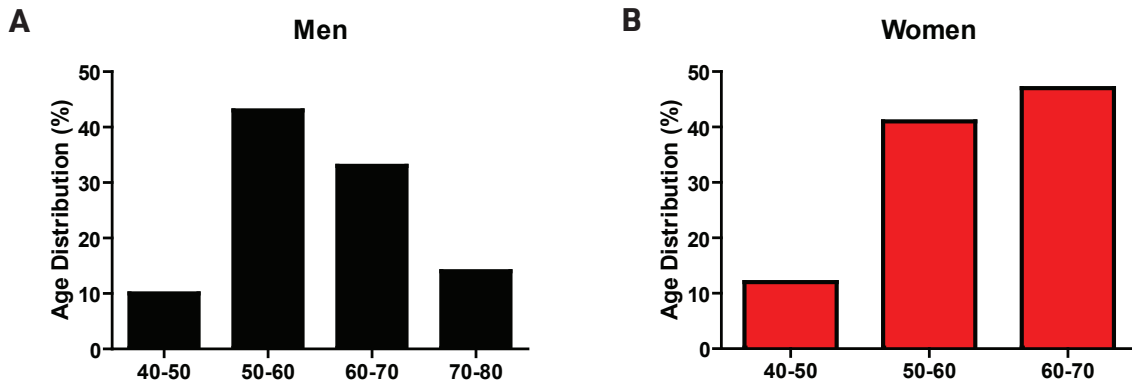


Figure 1. Age distribution of patients who underwent coronary artery bypass surgery. Age distribution is presented as percentage of number of patients (n value for men: 41, for women: 17).

while the majority of men (43%) were between 50-60 years-old. A different study performed on stable outpatients with suspected CAD demonstrated that mean age was 59 years for men and 62 years for women (Hemal et al., 2016). In accordance with that study, another study performed on patients undergoing CABG in Saudi Arabia demonstrated that women were significantly older than men (Ahmad et al., 2010). The discrepancy between these studies and our current results could be due to different ethnic groups included in these studies. In fact, Varma *et al.* compared the findings obtained from Indian and Western populations undergoing CABG (Varma et al., 2014). The mean age of Indian patients was 57 years while it was greater than 65 years in Western patients (Varma et al., 2014). This result is in accordance with the high risk profile of CAD in Asian-Indians (Ajay & Prabhakaran, 2010). Furthermore, a recent study investigated the ages of patients undergoing

CABG from 1997 to 2011 in the United States and reported an increase in the mean of patient age with time (Cornwell, Omer & Rosengart, 2015). Also, another study demonstrated an increase in mean age among US patients undergoing CABG from 2000 to 2009 (Elbardissi et al., 2012). These studies emphasized that ethnic groups and also the year when the studies were conducted could affect the results.

Obesity is an important risk factor for the development of CAD (Ades & Savage, 2017). Furthermore, obesity is found to be a significant independent predictor for adverse outcomes and prolonged hospitalization after CABG (Prabhakar et al., 2002; Terada et al., 2016). BMI values are frequently used for the estimation of obesity degree. In the present study, the average height of women was significantly lower than men while there was no difference in weight between both genders (Figure 2).

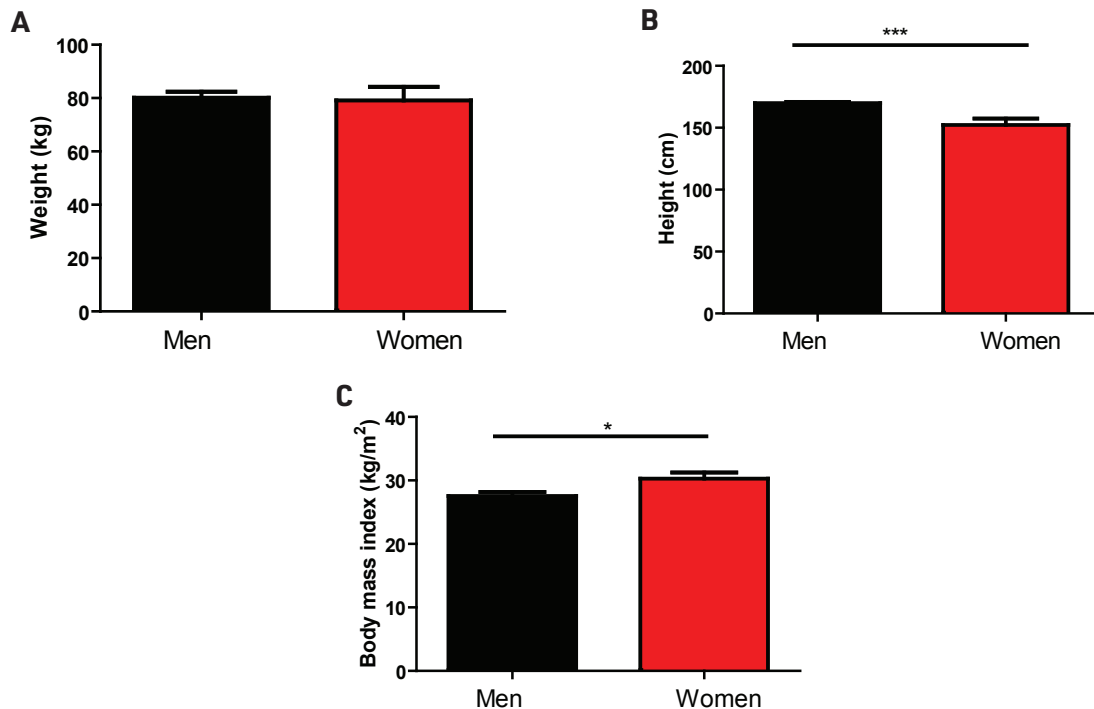


Figure 2. Weight, height and body mass index values of patients who underwent coronary artery bypass surgery. Body mass index is calculated by dividing weight in kg by height in meter squared. Values are means \pm s.e.mean derived from (n) different patients (n value for women: 17, for men: 41). * indicates values significantly different $p < 0.05$, *** indicates $p < 0.001$ (student's t test).

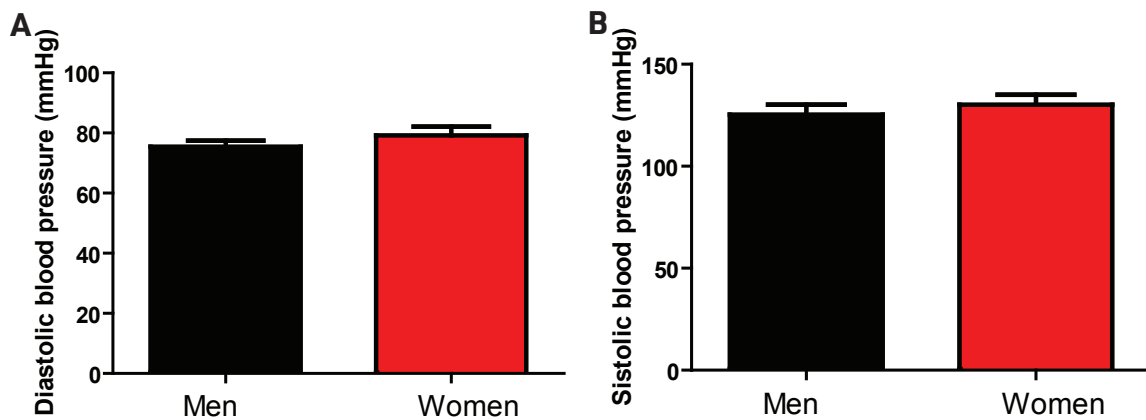


Figure 3. Diastolic and systolic blood pressure values of patients who underwent coronary artery bypass surgery. Values are means \pm s.e.mean derived from (n) different patients (n value for women: 17, for men: 41).

Furthermore, BMI values were significantly higher in women (Figure 2). In accordance with our results, another study indicated that the prevalence of morbid obesity is higher in those women undergoing CABG than men (Ahmad et al., 2010). On the other hand, another study performed on patients undergoing CABG demonstrated that women were shorter, weighed less and had a lower BMI compared to men (Koch et al., 2003; Terada et al., 2016).

It is important to note that diet and exercise lifestyle modifications could have a potentially significant role in improving cardiovascular risk factors in patients who undergo CABG. Several gender differences were noted in diet and sedentary life habits. Men are more likely than women to exercise multiple times with higher intensity levels while women are more likely to adhere to long-term dietary advice. Moreover, exercise could have more beneficial effects on women than men in regards to quality of life and functional outcomes. Further studies are necessary in order to elucidate reasons for these differences between gender (Coyan, Reeder, & Vacek, 2014; Markou, Evers & van Swieten, 2008).

Hypertension is associated with an increase in cardiovascular morbidity of CABG patients during the perioperative period (Aronson, Boisvert, & Lapp, 2002). Hypertension stage 1 is defined as systolic/diastolic blood pressure equal to 130/80 mmHg or above (Whelton et al., 2018). In our study, we indicated no difference in systolic and diastolic blood pressure between men and women (Figure 3). However, several studies reported that women with CAD were more likely to be hypertensive than men (Hemal et al., 2016; Ahmad et al., 2010).

The Framingham Heart Study reported that the presence of diabetes doubled the age-adjusted risk for CAD in men and tripled it in women (Kannel & McGee, 1979). The HbA1c value is used for long-term glycemic control in diabetic patients and correlates best with mean blood glucose over the previous 8 to 12 weeks (Rohlfing et al., 2002). In our study, no differences in HbA1c values between men and women undergoing CABG were observed (Figure 4). In accordance with our results, the prevalence of diabetes in both women and men was similar (Hemal et al., 2016). However, in another

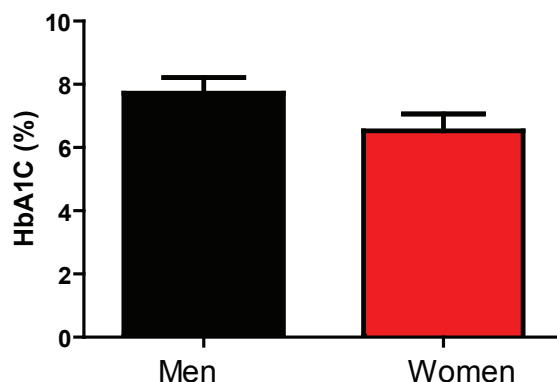


Figure 4. HbA1c values of patients who underwent coronary artery bypass surgery. The term HbA1c refers to glycated haemoglobin. Values are means \pm s.e.mean derived from (n) different patients (n value for women: 17, for men: 41).

study, female patients had an increased incidence of diabetes mellitus (Ahmad et al., 2010).

The incidence of CAD in several studies was inversely related to HDL concentrations and positively related to LDL concentrations. The Framingham Heart Study indicated that the risk of MI increases by 25% for every 5 mg/dL decrease in HDL levels for both men and women. On the other hand, lowering LDL levels is associated with a reduction in CAD (Castelli, 1983; Di Angelantonio et al., 2009; Praticò, Tangirala & Rader, 1998; Ference et al., 2017). In the present study, we indicated higher HDL and LDL levels in women compared to men (Figure 5). Furthermore, the ratios of HDL/total cholesterol and LDL/total cholesterol were greater in women than men (Figure 5). In accordance with our findings, another study indicated that women undergoing CABG had higher HDL, LDL and cholesterol values (Terada et al., 2016). Furthermore, several studies showed that female patients with CAD were more likely to have dyslipidemia than male patients (Ahmad et al., 2010). Higher LDL values observed in female patients could contribute to the progression of atherosclerotic CAD. In accordance with our results, a study performed in six countries reported that women have higher HDL values than men (Davis et al., 1996).

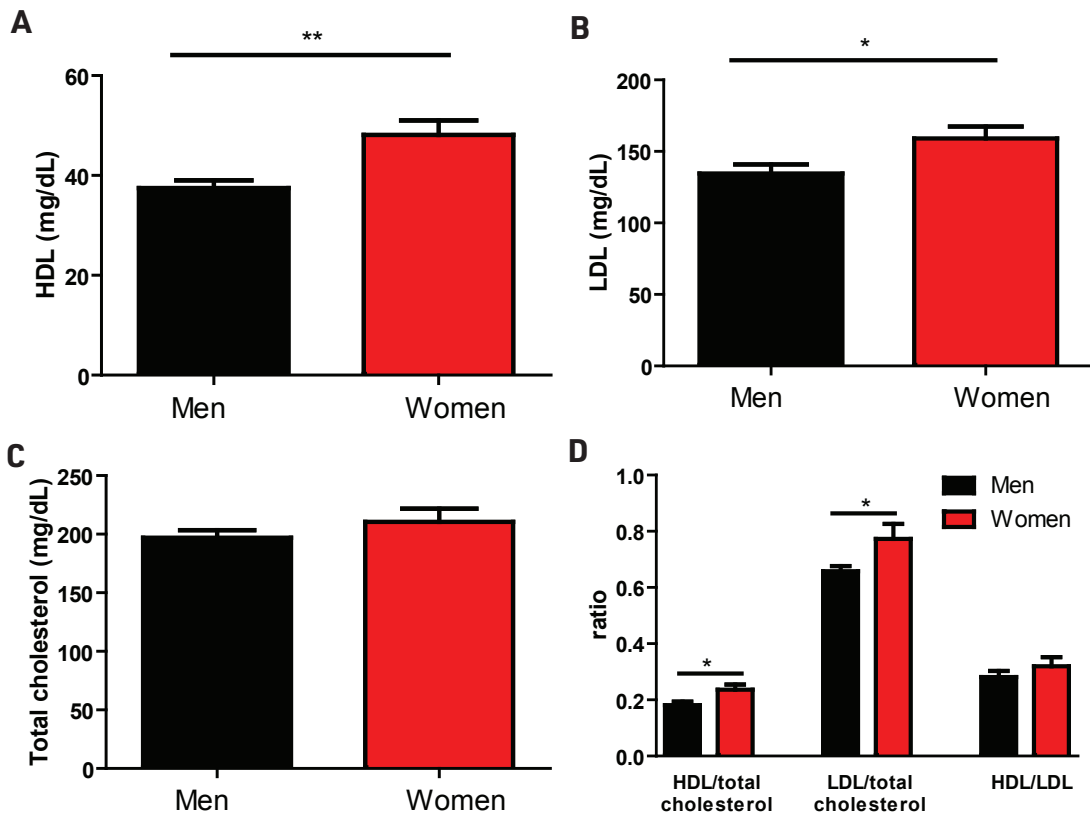


Figure 5. High-density lipoprotein (HDL), low-density lipoprotein (LDL), total cholesterol values and their ratios derived from patients who underwent coronary artery bypass surgery. Values are means \pm s.e.mean derived from (n) different patients (n value for women: 17, for men: 41). * indicates values significantly different $p < 0.05$, ** indicates $p < 0.01$ (student's t test).

In conclusion, the present study reported a significant difference in lipid profile and BMI between women and men undergoing CABG and highlighted the need for sex-specific approaches for the prevention of CAD. Several studies investigated a gender difference in clinical characteristics of patients undergoing CABG. Our study has both consistent as well as opposing results with those previous studies. This could be due to genetic predisposition, differences in ethnic groups, access to healthcare for diagnosis, and awareness of patients for cardiovascular risk factors. Risk factors including obesity, diabetes, hypertension and dyslipidemia influence the outcome of death in patients undergoing CABG. Correct management of controllable risk factors significantly reduces mortality and morbidity rates by altering the prognosis of CAD and is important for reducing hospital costs of these patients. Therefore, major socioeconomic education and preventive measures are needed to reduce the burden of major co-morbidities in patients with CAD and to seek early cardiac advice and care. A relatively low number of patients were included in the present study and this is one limitation of the study. Further multi-center studies including higher numbers of Turkish patients undergoing CABG with the focus on gender differences are needed.

Ethics Committee Approval: This study was approved by the Institutional Review Board of the Istanbul University Institute of Cardiology (no: 50.0.05.00/8).

Informed Consent: Written consent was obtained from the participants.

Peer-review: Externally peer-reviewed.

Author Contributions: Conception/Design of Study- G.Ö., S.T., G.T., G.T.; Data Acquisition- G.Ö., K.A., Ö.K.; Data Analysis/Interpretation- G.Ö.; Drafting Manuscript- G.Ö., K.A.; Critical Revision of Manuscript- G.T., S.T., G.T.; Final Approval and Accountability- G.Ö., K.A., Ö.K., G.T., G.T., S.T.; Technical or Material Support- Ö.K.; Supervision- G.Ö.

Conflict of Interest: The authors have no conflict of interest to declare.

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