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RISK FACTORS FOR BLOOD PRESSURE CHANGE AFTER CABG SURGERY IN SOUTHWEST OF IRAN

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Abstract: Coronary artery diseases are the first and most common cause of death in all ages. Heart surgery, as a common therapeutic intervention for patients with coronary artery disease, is considered a necessary treatment. However, patients demonstrate several pre- and post-operative complications. Among the common postoperative complications of coronary artery bypass grafting (CABG) are hemodynamic changes that are still considered a major problem. This study was to determine the extent of hemodynamic changes after coronary artery grafting along with relevant factors in patients under open heart surgery hospitalized in the heart surgery intensive care units. This was a descriptive study, and the sample population consisted of patients who had undergone coronary artery bypass surgery in Ahvaz Golestan Hospital. Files of 100 patients qualified to take part in the study were selected by employing the simple sampling method, and the required information was extracted from them using a checklist. The chi-square test and regression analysis were used to analyze the data. Research findings indicated that 35% of patients experienced postoperative systolic blood pressure changes out of the normal range, 45% experienced diastolic blood pressure changes, Moreover, the relationship of hemodynamic variables with interfering factors such as body mass index (BMI), ejection fraction, history of myocardial infraction, duration of cardiopulmonary machine use, hypothermia, and levels of hemoglobin and hematocrit was found to be significant. Findings of this research can be used for planning on the early prevention, diagnosis and treatment of the possible complications that can be experienced by patients undergoing coronary artery bypass grafting. This will result in the improvement of the quality of care provided to these patients.

Key Words: postoperative complications, coronary artery bypass, intensive care unit

INTRODUCTION

Cardiovascular diseases are the most common serious chronic and life threatening diseases in the world. In the United States, cardiovascular diseases account for 39.4% of mortalities [1]. According to the report by the World Health Organization (WHO), chronic diseases account for 70% of deaths in Iran. Of the aforementioned 70%, 42% is explained by cardiovascular diseases. Of cardiovascular disease, coronary artery diseases are the first and most common causes of deaths in all ages [2]. That is to say, every year 1.5 million people develop myocardial infarction and more than 600,000 people die of the complications of this disease [3]. It can be claimed that no treatment has influenced the life quality of patients with cardiovascular diseases other than heart surgery. Perhaps it can be said that coronary artery bypass grafting (CABG) using cardiopulmonary transplantation techniques has been the most revolutionary invention in heart surgery [4]. Coronary artery bypasses grafting (CABG) surgery is a common therapeutic intervention used for patients with coronary artery diseases. A total of 467000 surgeries were conducted by cardiovascular surgeons in the United States in 2003 [5]. Although heart surgery is a reliable means of enhancing myocardial perfusion, it has several side effects [6]. Due to the extracorporeal blood circulation in open heart surgery, a wide range of complications develop in the body [7]. Among the common postoperative problems are drastic hemodynamic changes. The incomplete drainage of blood and the liquids in the pericardial and pleural cavity directly or indirectly cause major problems a short while following surgery. These problems are manifested as reduced heart pumping, blood pressure changes, pulse changes, arrhythmia, and respiratory problems which lead to drastic postoperative changes [8]. Hence, following heart surgery it is necessary and inevitable to ensure proper drainage so as to prevent hemodynamic changes, hypovolemia, hypotension, and reduced cardiac output [9]. In addition, some of the most important factors involved in postoperative hemodynamic stability are rib cage drainage, and control over heart beats, rhythm, arterial blood pressure, and urine output [10]. Numerous risk factors are involved in the postoperative outbreak of hemodynamic complications. In this regard, hypotension is one of the most important postoperative changes. The following factors are also among the most important causes of hemodynamic changes: age, BMI, ejection fraction, the number of involved vessels, duration of extracorporeal blood circulation, preoperative blood pressure, duration of aorta clamp, levels of electrolytes, levels of

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preoperative hemoglobin, duration of anesthesia, and preoperative medical history [11]. According to Karhunen, drastic severe hemodynamic changes are among the severe lethal postoperative complications caused by CABG. He introduces these changes as the cause of sternotomy and reoperation [12]. Problems caused a short while after heart surgery to the patients are critical and acute. Therefore, such patients need special adequately quick care that can be provided by careful nurses in the intensive care unit. Nurses working in the heart surgery unit play an important role in the quick recovery of patients following operation by providing regular planned cares. On the other hand, due to the significance of heart surgery, nurses must have precise comprehensive knowledge of heart physiology, normal levels of hemodynamic parameters, side effects of using extracorporeal blood circulation during surgery, rib cage drainage, electrolyte disorders, and medicinal side effects. Controlling rib cage excretions is one of the most important tasks of nurses. Patients with a high level of chest tube discharges require careful controls. Since considerable blood loss leads to hemodynamic instability, it is very important to carefully control the blood excreted from the rib cage of patients. In this case, it is also necessary to transfer the patient to the operating room. Hemodynamic instability and reduced cardiac output are among the other complications that can outbreak in the early postoperative phases. These complications also call for special cares. In the early hours following heart surgery, patients may experience a drastic blood pressure decline, which can be prevented by rib cage drainage and blood pressure controls administered by nurses using a continuous cardiac monitoring device [13]. The prevalence of cardiovascular diseases (especially coronary artery diseases) is high and heart surgery is the most common intervention for the treatment of patients with such diseases. Moreover, the complications of this treatment are diverse while there is also a difference between the reported percentages of outbreak of the aforementioned complications in patients undergoing heart surgery. Hence, it was tried to carry out a study to investigate the hemodynamic changes experienced by patients undergoing CABG. Therefore, findings of this research and the information provided on the complications and requirements of such patients can be used by the aforementioned groups to take proper solutions as well as necessary therapeutic measures to prevent and address the complications of heart surgery. The results of this research can also be used in planning and implementation of training programs for the involved personnel and to take an effective step toward the enhancement of the conditions of patients and reduction of medical expenses.

METHODOLOGY

This was a cross-sectional study conducted in a Ahvaz Golestan Hospital, and the patients that had undergone CABG operations by a surgeon at the hospital constituted the sample population. The convenience sampling method was used based on entry criteria. The selected patients had CABG operations performed through a median sternotomy using a cardiopulmonary bypass (CPB) pump, their surgery was not urgent, and they had no previous open-heart surgery. Moreover, they were operated on by the same surgeon in the same center (the surgeon was selected at random from the list of surgeons working at the center), and the same protocols for anesthesia, cardioplegy, hypothermia, medications before surgery, and patient separation from mechanical ventilation were followed for all patients. These factors had to be the same to reduce intervening variables. For sampling, the researchers visited the hospital archives, received the files of patients who had undergone CABG operation in the period from late 2013 until late 2014, and selected patients who met the entry criteria for the research. Ninety-three patients were selected who had been candidates for CABG surgery and capable of autonomous breathing before surgery. The hemodynamic indicators such as systolic blood pressure, diastolic blood pressure, were recorded based on patients' files within the first 24 hours of hospitalization of patients in the intensive care unit. Patients included in the study had a preoperative normal systolic blood pressure varying between 90 to 140 mmHg and a diastolic blood pressure varying between 60 to 90 mmHg. Systolic postoperative blood pressures over 120 mmHg was considered to be hypertension while a blood pressure below 80 mmHg was considered to be hypotension. In order to determine the validity of the questionnaire, the researcher used the content validity assessment method as well as scientific books and articles on the research subject to prepare and design the question within the research conceptual framework. The data was analyzed in SPSS version 16 using descriptive and inferential statistics. After determining the frequency of data, research data was described, classified and compared. For the purpose of analytical examinations, first the normality of the quantitative variables was examined using the Kolmogorov–Smirnov test method. In order to study the distribution of hemodynamic changes in the interfering and background variables the Chi Square and Fisher test methods were employed. Linear regression models such as the logistic regression model were used to study the linear predictors of hemodynamic changes occurring after CABG. The results of these analyses were used to determine the factors associated with postoperative

complications. The significance level for the tests was assumed to be p<0.05.

RESULTS

Of the 100 patient under study 64.7% of the patients were male, 80% of whom were less than 65 years old, with the average age of 60.12±7.2. The highest systolic and diastolic above normal blood pressure was observed in women (20%) while the highest below normal systolic blood pressure was observed in men (15%). Postoperative blood pressure decline was more prevalent. Upon entering the intensive care unit, 25% of the patients had a systolic blood pressure of below 80 mmHg while 14% of patients had a systolic blood pressure of over 120 mmHg. The frequency of below normal systolic blood pressure and above normal blood pressure within 24 hours of hospitalization in the intensive care unit was 2.8% and 21.5%, respectively. Moreover, 35% of the patients showed a diastolic blood pressure of below 60 mmHg upon entering the ICU while 17% of the patients had a diastolic blood pressure of higher than 90 mmHg. The frequency of below normal diastolic blood pressure and above normal blood pressure within 24 hours of hospitalization in the intensive care unit was 5% and 8%, respectively Results indicated that the relationship of postoperative blood pressure decline with history of blood pressure (P<0.001), history of diabetes drugs (p<0.00) and intraoperative reduction in body temperature (p<0.036) is significant. Moreover, results revealed that the relationship of postoperative hypertension with history of blood pressure (p<0.006), is also significant. Moreover, the relationship of postoperative diastolic blood pressure decline with history of blood pressure (p<0.02) and history of cardiac drugs use (p<0.02) was also found to be significant. The relationship of postoperative diastolic blood pressure increase with BMI (p<0.03) and medicinal history of patients (p<0.04) was significant too.

DISCUSSION AND CONCLUSION

Research results indicated that the relationship between history of blood pressure and post-CABG changes of hemodynamic indicators (hypotension: p<0.001, hypertension: p<0.006, and reduced diastolic pressure: p<0.02) is significant. Diabetes also influenced post-CABG hemodynamic changes. Research results indicated that the history of diabetes drugs use is significantly related to postoperative hypotension (p<0.008). Results of the studies by Wang *et al.,* revealed the significant relationship between diabetes and post-CABG hemodynamic changes (p<0.001) [14]. According to the researcher, hypothermia leads to increased blood viscosity and vasoconstriction, which in turn lead to postoperative hemodynamic instability. In this regard, Lewis *et al.,* stated that there is a significant relationship between hypothermia and postoperative heartbeat (p<0.0001) [15]. In addition, Dickson also reported that intraoperative hypothermia has a significant relationship with systolic blood pressure, diastolic blood pressure, number of heart beats, and respiratory rate [16]. According to the researcher, smoking can lead to the release of nicotine in the body and increase heartbeat, blood pressure, stroke volume, cardiac output, and blood flow in coronary arteries. In his study, Foroutan studied the relationship between supraventricular arrhythmias and post-CABG absorption and desorption of liquids and electrolytes. He stated that history of drug abuse is one of the important factors contributing to the development of hypoxia, acidosis, ischemia, and hemodynamic instability. Moreover, there is a direct relationship between duration of drug abuse and the aforementioned conditions [17]. Findings of the present study also indicated that postoperative hypertension complications are associated with the number of involved vessels (p<0.03) and number of grafts (p<0.02). Mohanti *et al.,* also reported that patients undergoing CABG using mammary artery graft require longer operations and aorta clamp. This increased also leads to the outbreak of more postoperative complications. Due to vast postoperative separations and freeing of pleural spaces patients experience more bleeding than the bleeding caused by venous grafts. This increased hemorrhage can in turn lead to hemodynamic instability following operation [18]. On the other hand, a significant relationship was also observed between history of cardiac drugs use and post-CABG hemodynamic complications. Fipps states that patients with a history of cardiac drug use manifest arrhythmia and hemodynamic instability because consumption of calcium blockers influences vascular smooth muscles and myocardial muscle which eventually lead to reduced cardiac contractility and postoperative hemodynamic changes [19]. In the present study a significant relationship was observed between the outbreak of post-CABG hemodynamic changes (tachycardia: p<0.015; reduced central venous pressure: p<0.32; increased central venous pressure: p<0.180) and ejection fraction. In this regard, Philsoophi carried out a studied titled "predictors of early outbreak of complication in patients under coronary artery bypass grafting with an ejection fraction below 20%". Results of this study indicated that there is a significant difference between preoperative ejection fraction and postoperative blood pressure (P<0.003) [20]. With a reduction in the ejection fraction, cardiac output declines and eventually leads to changes in the heartbeat, venous return, peripheral vascular resistance, and cardiac

contractility [21]. Another factor associated with the post-CABG hemodynamic changes, which was also studied in the present research, is duration of aorta clamp which was significantly related to increased postoperative heartbeat ($p<0.000$). During heart surgery, at one point the heart should stop working to clamp the patient's aorta. At this phase, due to the lack of perfusion by the heart, this organ uses fatty acids as its source of energy. In such conditions, glycogenolysis and glycolysis occur due to the existing anaerobic metabolism. This also leads to the production of hydrogen ion and lactate. As this trend continues, production of lactate acid leads to ATP defibrillation. As a result of the rapid consumption of ATP, the levels of creatinine phosphate drop and the myocardia muscle partly loses its contractility. Consequently, hemodynamic indicators manifest changes [22, 23]. In this research, the levels of hemoglobin and hematocrit were the other factors that were associated with postoperative hemodynamic changes (increased central venous pressure: $p<0.029$ and $p<0.026$). Gabriel assets that the significance of the relationship of intraoperative hemoglobin and hematocrit levels with postoperative hemodynamic changes can be explained by the fact that dilution of blood during cardiovascular bypass of patients undergoing CABG leads to increased postoperative bleeding. Complications of cardiopulmonary CABG are associated with factors such as renal disease, diabetes, blood pressure, levels of hemoglobin and hematocrit, and low cardiac output. Moreover, severe dilution of blood and reduction in the levels of hemoglobin and hematocrit lead to a reduction in the oxygen transport capacity and the amount of oxygen delivered to critical body tissues [25]. According to the research findings, the most common factors associated with post CABG complications are reduced postoperative hemoglobin and hematocrit levels, duration of connection to ventilator, history of myocardia infraction, and duration of aorta clamp. Due to the significance and diversity of post CABG complications it is necessary to investigate other early complications as well as late postoperative complications such as cardiovascular, digestive, neural and respiratory complications as well as arrhythmia and mental problems.

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