Evaluation of Saphenous Vein with or Without Valve, and Radial Artery Patency Via Tomography in Cases That Underwent Coronary Artery Bypass Grafting

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ABSTRACT

Introduction: This is a prospective study and it has been investigated not only the effect of valves of saphenous veins, which were used as conduits, on patency, but also 2-years rate of remaining patentcy for saphenous vein with valve, saphenous vein without valve and radial artery via Multy Slice Computarized Tomography (MSCT) Angiography.

Materials and Method: Between 2014-2015 year in our clinic, patients that underwent Coronary Artrey Bypass Grafting (CABG) were grouped depending on three different grafts. Groups were established according to the grafts used in the patients that underwent CABG using Cardiopulmonary Bypass (CPB) and cross-clamp (On-Pump with cross-clamp). The first group (Group 1); radial artery group, the second group (Group 2); great saphenous vein with valve group, the third group (Group 3); great saphenous vein without valve group.

Results: The 2-years rates te of remaining patency for the these grafts in decreasing order was as following: radial artery (87.5%), great saphenous vein without valve (82.4%), and great saphenous vein with valve (78.8%).

Conclusion: The rate of remaining patency was not statistically significant among radial artery, saphen wein without valve, saphen wein with valve conduits ($p>0.05$; $p= 0,737$ for radial artery vs vein witout valve; $p=0,321$ radial artery vs vein wih valve; $p=0,465$ for vein witout vave vs vein with valve)

Keywords: CABG,Saphein vein,Radial artery,Computarized Tomography;

Koroner Arter Bypas Operasyonu Olan Vakalarda Kapaklı Kapaksız Safen Ven ve Radial Arter Açıklığının Tomografik ile Araştırılması

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ÖZET

Giriş: Çalışmamız Prospektif bir çalışma olup yalnızca konduit olarak kullanılmış safen venlerin kapakçıklarının açık kalma üzerine etkisi değil, aynı zamanda kapaklı safen venin, kapaksız safen venin, radyal arterin 2 yıllık açık kalma oranı Çok kesitli Bilgisayarlı Tomografi (ÇKBT) anjiyografi kullanılarak araştırılmıştır.

Hastalar ve Metod: Kliniğimizde 2014-2015 yılları arasında Koner Arter Bypas Greft Operasyonu (KABGO) yapılmış hastalar üç farklı grefte göre gruplandı. Gruplar Kalp Akciğer Makinası ve X-klemp (On-Pump X-klempli) kullanılarak KABGO yapılan hastalarda kullanılan greftlere göre oluşturuldu. Birinci grup (Grup 1); Radial arter grubu, ikinci grup (Grup 2); Valvli safen ven grubu, üçüncü grup (Grup 3); Valv içermeyen safen ven grubu olarak belirlendi.

Bulgular: Greftlerde iki yıllık açık kalma oranı, radyal arter için % 87.5, kapaksız safen ven için % 82.4 ve kapaklı safen ven için % 78.8 bulunmuştur.

Sonuç: Radyal arter, kapaksız safen ven, kapaklı safen ven arasında iki yıllık açık kalma oranları, istatistiksel olarak anlamlı değildir (p> 0.05; radyal arter vs valvsiz ven için p=0,737; radyal arter vs valvli ven için p=0,321 ; valvsiz ven vs vavli ven için p=0,465)

Anahtar Kelimeler: KABGO, Safen ven, Radial arter, Bilgisayarlı Tomografi

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Manuscript

Introduction

Coronary artery diseases are the leading cause of death observed in the populations of developed countries populations. For this reason, coronary artery bypass (CABG) surgery is one of the operations most frequently performed in the world and approximately more than 800,000 patients undergo this surgery in a year[(1)] . Conventional CABG is performed using cardiopulmonary bypass device (heart-lung machine) (CPB) and is called as on-pump CABG.

In CABG, various autogenous grafts are used to bypass the coronary arteries. Besides ITA (Internal thoracic artery = Internal mammary artery), the second choice of graft has always been the matter of debate. Patency of ITA graft used in coronary by-pass surgeries is better than other grafts in almost all studies and periods. Here, many factors including the structure of coronary artery that is undergoing grafting, degree of stenosis, structure of graft, resection technique, and quality of anastomosis play a role. Great saphenous vein and radial artery are the second and third most frequently used grafts respectively. The fact that radial artery is most commonly used as an arterial graft depends on suitability of diameter-length and ease of harvesting.

This is a prospective study and it has been investigated not only the effect of valves of saphenous veins, which were used as conduits, on patency, but also 2-years rates of remaining patency for saphenous vein with valve, saphenous vein without valve, radial artery a via Multy Slice Computarized Tomography (MSCT) Angiography.

Material and Methods

Clinical Characteristics of Patients

In the present study, all study participants were Caucasians and do not represent the other ethnic groups. The study comprised the patients that underwent CABG surgery and postoperative MSCT angiography in our clinic between 2014-2015 year. This study was designed as a prospective study. Data were collected prospectively form following patients. Approval of the ethics committee was obtained. This study is are including conduits from 50 participants

All patients were questioned about medical history and they underwent detailed physical examination. In the preoperative period, standard preoperative laboratory analyses, transthoracic echocardiography (TTE) (Acuson, Mountain View, Acuson Sequoia C 256), pulmonary function test (Spirobank Spirometry, MIR medical IRR) and bilateral carotid artery Doppler ultrasonography (Toshiba XARIO primeultrasound) were performed in our clinic. Thorax, ascending aorta and aortic arch calcifications were evaluated by standard telegram prior to the surgery. During surgery, the entrances of ascending aorta and aortic arch were carefully evaluated by manipulation. The procedure was amended for the patients in whom plaque was detected by manipulation and they were excluded.

In the preoperative period, the use of clopidogrel (if any) was discontinued five days prior to the surgery and the use of acetylsalicylic acid was discontinued one day prior to the surgery in the cases undergoing On-Pump (cross-clamping) CABG. In the preoperative period, blood glucose regulation in the patients with type 2 diabetes mellitus was done with regular insulin both before and after surgery. Blood glucose concentration of the patients was kept below 200 mg/dl. In the preoperative period, blood samples of study participants were taken into standard tubes containing ethylene diamine tetra acetic acid (EDTA) as the anticoagulant agent. These samples were analyzed using Cell-Dyne 3700 (Abbott, Abbott Park, IL, USA) device. Prothrombin time (PT), activated partial thromboplastin time (aPTT) and international normalized ratio (INR) were measured.

Dyslipidemia in study participants was described as fasting serum low-density lipoprotein (LDL) cholesterol ≥ 160 mg/dl, triglyceride ≥ 200 mg/dl, total cholesterol ≥ 240 mg/dl and/or high-density lipoprotein (HDL) cholesterol < 40 mg/dl, as well as receiving or not active drug therapy for this [(2)]. Serum cholesterol concentration was measured by enzymatic method. Staged approach was adopted and saved for post-CABG period for the patients, in whom carotid artery disease was detected to be over 70% and below 100% before surgery.

Surgical procedure

All study participants were operated by the same surgery team and first underwent isolated CABG surgery. Fentanyl, midazolam and pancuronium bromide were used for the induction of anesthesia. Standard median sternotomy was performed. LIMA and other vascular conduits (saphenous vein and radial artery) were prepared. Heparin sodium (Nevparin® flacon 25000 IU/5 ml) was administered at a dose of 300 IU/kg.

CPB and cross clamp, standard aortic and two stage venous cannulas were used. Jostra-Cobe (Model 043213 105, VLC 865, SWEDEN) heart-lung machine was used. Crystalloid cardioplegy was given to all patients during surgery and hot shot cardioplegy was given at the end of surgery. Whilst the left internal mammary artery (LIMA) was used in all cases, the right internal mammary artery was not used. Great saphenous vein and radial artery were used as grafts. Valve control of the conduit segments of saphenous vein was done by administering physiological serum through the distal end using olive-tip injector. LIMA was preferred as the conduit for the left anterior descending (LAD) coronary artery, radial artery (RA) was preferred for circumflex coronary artery and great saphenous vein (with or without valve) was preferred for right coronary artery or diagonal coronary arteries of LAD. It was recorded which graft has been used for which coronary artery. Meticulous aseptic technique was performed during surgery. Entrances of ascending aorta and aortic arch were examined precisely via manipulation during surgery. Procedure was amended for the patients in whom plaque was detected by manipulation and these patients were excluded. Unnecessary electrocautery usage and luxury perfusion in CPB were avoided. Hematocrit (hct) and hemoglobin (hb) values were checked every 20 minutes after the induction of anesthesia until the completion of surgery. Intraoperative blood transfusion was performed when hematocrit value decreased to 20%. Full revascularization was performed. Mediastinum and chest drains were placed subxyphoidally. Proximal anastomoses to the aorta were performed by using side clamp. At the end of surgery, patients that underwent CABG received protamine hydrochloride (Protamin® ampoule 1000 IU/1 ml) at appropriate dose for full-dose neutralization and activated clotting time (ACT) was kept between 100-120 second. Some datas relevant to surgery are demonstrated in Table 1.

Graft patency was evaluated by cardiac tomographic angiography performed after discharge at the earliest 2 years later. For the present study, patients were selected among those aged 50-70 years and underwent multiple-artery coronary bypass surgery regardless of gender difference. It was stipulated that all patients must have undergone bypass surgery as supported by heart-lung machine with the heart stopped and that radial artery and saphenous vein must have been used as grafts in all patients. Patients that have been discharged without any complication were enrolled.

Postoperative care

At the end of surgery, the patients were admitted to the Cardiovascular Surgery(CVS) intensive care

unit (ICU). They were monitored at ICU for hct and Hb every four hours. We tried keep hct level at 28 % in all patients in ICU.

In the postoperative period, acetyl salicylic acid (Coraspin 300®) 300 mg/day was commenced together with enteral nutrition for all patients to reduce the risk of stroke after CABG. Cefazolin sodium (Cefamezin®-IM/IV) 1 gr, which is used as standard prophylactic antibiotic in our clinic, was given as a single dose 30 min before surgery and every 8 hours after surgery and continued for 72 hours. Blood glucose regulation in diabetic patients was done strictly with insulin glargine 100 IU/ml (Lantus® flacon) and human soluble regular insulin 100 IU/ml (Humulin-R® flacon) after surgery. Insulin infusion was not avoided in case of necessity. Blood glucose concentration was kept below 200 mg/dl in all diabetic patients. Radial artery grafts are more spasmodic than other grafts particularly than saphenous grafts. In this causes, after harvesting, all radial arteries keept moderate warm solution including diltiazem, papaverin, heparin.

After staying at CVS intensive care unit for 48 hours in the postoperative period, the patients were then transferred to the CVS clinic within the third 24 hours. The patients were discharged from the hospital between Days 6 and 11 after surgery.

Statistical Analysis

Statistical analyses were done using SPSS program (SPSS Inc., Chicago, IL, USA). Statistical significance of nonparametric data between the groups was analyzed by Chi-Square Test and Ficher's Exact Test (because observed values were below the expected values). Parametric data were shown as minimum, maximum and mean ± standard deviation. Statistical significance of parametric data between the groups was analyzed using Kaplan Meier test. The result was considered statistically significant if two-tailed p value was smaller than 0.05 (Table 1).

MSCT Image Reconstruction and Occlusion evaluation

MSCT angiography was performed by Somatom Sensation 64 (Siemens, Forchheim, GERMANY) tomography device and scanning parameters were chosen as following: gantry rotation time 330 milliseconds, tube voltage 120 kilowatt and 250 milliamper (mA), and detector collimation 0.6 millimeter. Images were obtained at a single breath in approximately 8.4 -13.1 seconds and in cranio-caudal direction from carina to subcostal level. During MSCT angiography, 80-110 milliliters of non-ionized contrast agent (Iomeron 400, Bracco s.p.a., Milan, ITALY) depending on the patient’s body weight was given rapidly through

antecubital vein at a speed of 5.0 milliliter (ml)/second followed by 40 ml normal saline given as bolus infusion. Automatic peak contrasting density obtained from ascending aorta was specified as +140 Hounsfield units. Reconstruction was obtained according to the retrospective electrocardiography synchronization technique enhancing 0.6 mm artifact free image sections by 0.6 mm images in multiplanar reformat and three-dimensional volumetric display (volume rendering) format were created from axial thin sections and coronary artery anatomy was evaluated.

All coronary artery segments and grafts were examined visually. Stenoses were classified as total occlusion (100% stenosis), severe stenosis (70% and higher stenosis), and mild stenosis-complete patency (stenosis lower than 70%). MSCT angiography examinations were performed as by independent radiologists, cardiovascular surgeons and cardiologists. (Figure 1,2,3,4)

Study Groups

Patients that underwent CABG were grouped depending on three different grafts. Groups were established according to the grafts used in the patients that underwent CABG using CPB and cross-clamp (On-Pump with cross-clamp). The first group (Group 1); radial artery group, the second group (Group 2); great saphenous vein with valve group, the third group (Group 3); great saphenous vein without valve group. In all patients, CABG was performed in three or more coronary arteries on CPB Left internal mammary artery, radial artery and saphenous vein were used as grafts in the subjects participated in the study. Graft choice and coronary anastomosis sites were recorded in these patients. Different from the standard procedure, whether or not there is valve in the saphenous vein used was also reported. Proximal anastomoses were performed using side clamp. Duration of cross-clamp did not exceed 90 minutes and duration of cardiopulmonary bypass did not exceed 120 minutes in the patients that underwent CABG by CPB with cross-clamp technique. In order to create a homogeneous group, dialysis patients or the patients with creatinine level higher than 2gr/dl, patients with aortic pathology detected during surgery and thereby in whom surgery procedure was amended, patients that underwent surgery in emergency status, patients that underwent redo-CABG, and patients that underwent CABG without touching ascending aorta (No-touch) or LIMA-LAD (single vascular disease patients) CABG were not included in the study. Moreover, patients that underwent second CABG surgery, in whom valve and coronary artery surgeries performed in the same session, patients that were in need of postoperative IABP support, patients that were re-explored due to any

postoperative reason, patients that underwent CABG in emergency status, and dialysis patients were also excluded to create more homogeneous and similar groups.

Patients who have allergy against contrast agent, chronic obstructive pulmonary disease, atrial fibrillation, tachycardia, or rhythm disorders, which would hinder MSCT angiography imaging, were not included in the study. Among eligible patients for study criteria, those who accepted the risk of coronary CT angiography, wanted to participate in the study, and had appropriate pulse for coronary CT angiography were selected. Accordingly, 50 patients were enrolled. MSCT angiography was performed approximately 34.9±4.8 months later to assess graft patency in the patients that were discharged from the hospital following on-pump CABG surgery.

Results

Group 1 characteristics

There are 40 patients in group 1 and 33 (82.5%) of them were male, mean age (±standard deviation) was 60.2±10.2 y, the mean BMI (±standard deviation) was 39.8±7.2 kg/m^2, mean preoperative EF (±standard deviation) was 50±9.1, number of patients with stenosis (70%≤ lesion<100%) in the right carotid artery was 0 (0%), and the number of patients with stenosis (70%≤ lesion<100%) in the left carotid artery was 0 (0%). There were 2 (6.1%) subjects with peripheral arterial disease (PAD).

For the females of Group 1; it was determined that the number was 7 (17.5%), mean age (±standard deviation) was 61.4±7.6 y, mean BMI (±standard deviation) was 38.8±7.4 kg/m^2, mean preoperative EF (±standard deviation) was 45.5±11.2, number of patients with stenosis (70%≤ lesion<100%) in the right carotid artery was 0 (0%), and the number of patients with stenosis (70%≤ lesion<100%) in the left carotid artery was 0 (0%). There was no (0%) subject with PAD.

Group 2 characteristics

For the males of Group 2; it was determined that the number was 24 (72.7%), mean age (±standard deviation) was 64±9.1 y, the mean BMI (±standard deviation) was 39.4±6.3 kg/m^2, mean preoperative EF (±standard deviation) was 50.4±7.9, number of patients with stenosis (70%≤ lesion<100%) in the right carotid artery was 0 (0%), and the number of patients with stenosis (70%≤ lesion<100%) in the left carotid artery was 0 (0%). It was observed that there are 3 (12.5%) subjects with PAD.

For the females of Group 2; it was determined that the number was 9 (27.3%), mean age (±standard

deviation) was 63.4±8.2 y, the mean BMI (±standard deviation) was 37.2±7.4 kg/m^2, mean preoperative EF (±standard deviation) was 46.7±10.9, the number of patients with stenosis (70%≤ lesion<100%) in the right carotid artery was 0 (0%), and the number of patients with stenosis (70%≤ lesion<100%) in the left carotid artery was 0 (0%). There was no (0%) subject with PAD.

Group 3 characteristics

For the males of Group 3; it was determined that the number was 40 (78.4%), mean age (±standard deviation) was 60.2±12.4 y, the mean BMI (±standard deviation) was 40.9±6.1 kg/m^2, mean preoperative EF (±standard deviation) was 52.7±8.4, the number of patients with stenosis (70%≤ lesion<100%) in the right carotid artery was 0 (0%), and the number of patients with stenosis (70%≤ lesion<100%) in the left carotid artery was 0 (0%). There were 3 (7.5%) subjects with PAD.

For the males of Group 3; it was determined that the number was 11 (21.6%), the mean age (±standard deviation) was 63.4±7.5 y, mean BMI (±standard deviation) was 35.9±8.5 kg/m^2, mean preoperative EF (±standard deviation) was 46.7±11.6, the number of patients with stenosis (70%≤ lesion<100%) in the right carotid artery was 0 (0%), and the number of patients with stenosis (70%≤ lesion<100%) in the left carotid artery was 0 (0%). There was no (0%) subject with PAD.

Discussion

Conventional coronary angiography is the gold standard in evaluating coronary artery diseases [(3)] . However, the method's being invasive and causing serious complications, although rare, necessitates development of a non-invasive, effective and reliable alternative diagnostic method. Along with the development of multi-slice computed tomography (MSCT) systems, CT coronary angiography has become one of the most common fields of practicing[(4)] . The most significant advantages of CT coronary angiography as compared to conventional angiography are ease of application, not requiring preparation period, follow-up or hospitalization, being extremely comfortable for patient and the most important, not having risk for serious complication due to being non-invasive. Owing to their large diameters, less prevalence of calcification and being relatively motionless, bypass grafts are the configurations that can be visualized more easily by CT than coronary arteries. Venous grafts in particular can be visualized clearly. The sensitivity and specificity of MSCT in detecting graft occlusion are 100% for each [(4)]. The sensitivity and specificity of MSCT angiography in detecting severe stenosis in graft was reported to be 96% and 100%, respectively[(4)] . Although there are

differences between the studies in general, there are studies and information that early phase (first one-year period) saphenous vein patency is similar to that of radial artery but in the late phase (after one year) radial artery patency is better[5] . While choosing the conduit, the surgeon should consider suitability for anatomic structure, patient characteristics, availability for grafting, and his/her own surgical experience.

Limited long-term patency of the veins used in coronary bypass surgery has been demonstrated very clearly[6-8]. Veins are prone to early atherosclerosis due to their flow characteristics and being exposed to aortic pressure. In addition, they are different from the arteries as they contain valve, as well as due to their endothelium and wall structure. Definite cause of early atherosclerosis, however, is not clear yet. Standardly, resistance and elasticity of the valves reversely interposed in the veins against arterial pressure and their effect on thrombosis are not well-documented.

Studies demonstrating radial artery patency are either inadequate or superficial. Whilst early studies have reported the patency rate of radial artery between ITA and saphenous vein, recent studies emphasize just the opposite. In a recent study, based on angiography results, Khot et al. reported that radial artery patency is poorer than ITA and saphenous vein[89 All studies reported that LIMA patency is higher in all periods. Duration of remaining patency in the postoperative period for radial artery and great saphenous vein, which are used as the second and third choices of graft respectively, has always been the matter of debate. Although early studies emphasized that the rate of patency is better for radial artery, recent studies opine that the rate of patency is better for great saphenous vein.

Whitney et al. demonstrated that reversely interposed valve areas of saphenous vein cause turbulent flow and dilation [10]. Chaux et al. conducted an experimental study in the valve area of jugular veins of hypercholesterolemic rabbits and demonstrated that valve area created turbulent and a focus for atherosclerosis, and atrophied valve area posed a potential for endothelial injury, formation of microthrombi and thrombocyte aggregation [11] Based on experimental and clinical data, Lojas et al. called the veins without valve as ‘good veins’ and recommended to use in by-pass surgeries and suggested that there is long patency in arterial grafts except for ITA [12].

Combining their findings with earlier publications, Cohen et al. suggested that radial artery graft is better than saphenous vein in coronary by-pass surgeries and that has higher rate of patency comparable with that of the right ITA[13] Athanasiou et al. performed a meta-analysis and systematic review between 1965

and 2009 consisting of 35 publications and stated that early-phase (before the first one year) patency rates of radial artery and saphenous vein are similar but late-phase (1-5 years) patency is better for radial artery and that radial artery graft should be the first choice in coronary by-pass surgeries[5].

In a study[14] conducted in 2004, radial artery occlusion was detected by 8.2% and saphenous vein occlusion was detected by 13.6%. The rate of string sign appearance was 7% in radial artery and 0.9% in saphenous vein. In the same study, it was observed that radial artery occlusion was equal in males and females and that patency of radial artery that bypassed to the circumflex coronary artery is similar to that bypassed to the right coronary artery. Saphenous vein occlusion was reported to be more prevalent in females. The rate of radial artery patency was determined to be higher in diabetics and in those with peripheral vascular disease[14]

Modine et al. carried out a study in elderly aged over 65 years and reported that using radial artery in such patients is practical, harmless and does not enhance morbidity or mortality[15] Engoren et al. reported that radial artery outcomes were better in elderly at the end of 12-year period as was in the other age groups[16]. Georghiou et al. reviewed many studies and suggested that saphenous vein patency ranks second after radial artery and that radial artery can be readily used for the stenosis with thin native coronary structure[167].

As the result of angiography performed a week after and a year after the surgery, Goldman et al. indicated no difference between saphenous vein and radial artery groups in terms of the rate of remaining patent[18] The same study reported that the rate of remaining patency is better in saphenous veins removed by open surgery as compared to the veins removed endoscopically and that the rate of remaining patent was better at the end of one year for the saphenous veins implemented by on-pump surgery. String sign appearance due to the degree of coronary artery stenosis was observed to be more prevalent in radial artery grafts[18] Whilst there was no difference between radial arteries removed by endoscopic or open surgical methods in terms of the rate of remaining patent, the rates of remaining patent were the same also between the subjects underwent on-pump or off-pump CABG surgery. The study emphasized that the rate of remaining patent at the end of one year was better for radial artery versus saphenous vein in type 2 diabetic patients [18]. Acar et al. reported the late-phase rate of remaining patent at the end of 5 years to be 83% for the left internal mammary artery, 87% for the right internal mammary artery, 83% for radial artery, and 81%

for great saphenous vein. The rate of remaining patent for the radial artery anastomosed to the LAD branches was 93%, anastomosed to the circumflex coronary artery was 82.5%, and anastomosed to the right coronary artery was 77.6%. The most significant finding of this study is that rate of remaining patent was better for RIMA versus LIMA, which is not found in any study [19]. Yie et al. conducted a study between 2002 and 2006 in 123 patients and reported radial artery patency to be 92% at the end of 32 weeks and stated that radial artery patency is better in the coronary arteries with serious degree of stenosis [20]

Considering the studies up to now, LIMA patency is better in coronary by-pass surgeries independent from time. As the second choice graft, it is observed that radial artery patency in the intermediate and late phases is superior to saphenous vein patency.

Conclusion

The rate of remaining patency for the other grafts in decreasing order was as following: radial artery (87.5%), great saphenous vein without valve (82.4%), and great saphenous vein with valve (78.8%).

The fact that the rate of remaining patency is the highest for LIMA is consistent with the studies conducted until today. However, superiority of radial artery and great saphenous vein with or without valve conduits in terms of remaining patency has not been clearly identified. We believe that the mentioned outcome should be supported in large-scale studies.

Study Limitations

In the present study, all study participants were Caucasians and do not represent the other ethnic groups. Patients that would impair the similarity between the groups, such as patients with renal insufficiency and dialysis patients and redo CABG cases etc., have not been included in the study. This study have not power analysis. Statistical insignificans could be shown because of participitants counts was low.

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Table 1 Datas according to groups

	Group 1 (n=40) (Radial artery)	Group 2 (n=33) (saphen vein with valve)	Group 3 (n=51) (Saphen vein without valve)	p values
Age (±SD) (year)	60.4 ±9.7	63.9±8.8	60.9 ±11.5	0.308[A]
Gender (Male)	33 (82.5%)	24 (72.7%)	40 (78.4%)	0.602[P]
PAD	2 (5%)	3 (9.1%)	3 (5.9%)	0.923[S]
Right carotid artery				
stenosis<%50	11 (27.5%)	14 (51.5%)	18 (35.3%)	
%50< stenosis≤%70	0	2 (6.1%)	2 (3.9%)	*0.169[S]
% 70≤ stenosis<%100	0	0	2 (3.9%)	
stenosis=%100	0	0	0	
Left carotid artery				
stenosis<%50	3 (7.5%)	2 (6.1%)	4 (7.8%)	
%50< stenosis≤%70	1 (2.5%)	2 (6.1%)	0	*0.109[S]
% 70≤ stenosis<%100	0	0	0	
stenosis=%100	2 (5%)	1(3%)	0	
Body Surface Area	1.8±0.1	1.8±0.1	1.8±0.1	0.693[A]
Body Mass Index	39.7±7.1	38.8±6.6	39.8±6.9	0.796[A]
Preoperatif Ejection Fraction	49.3±9.5	38.8±6.6	39.8±6.9	0.478[A]
The period of from CABG untill MSCT angiography (month)	34.9±5.4	35±4.9	34.4±4.3	1[A]
Ejection Fraction (Before MSCT angiography)	62.6±9.6	57.3±9.9	60.3±9.8	0.074[A]
Graft Patency	35 (87.5%)	26 (78.8%)	42 (82.4%)	0.604[P]

[A]: P value was presented as a result One-way ANOVA test
[P]: P value was presented as a result Pearson Qi-square test
[S]: P value was presented as a result Spearman Correlation test**s**
* P value was calculated according to no carotid artery stenosis
BMI: Body Mass Index, SD : Standart deviation, PAD: Peripheral artery disease, CABG: Coronary Artery Bypass Grafting

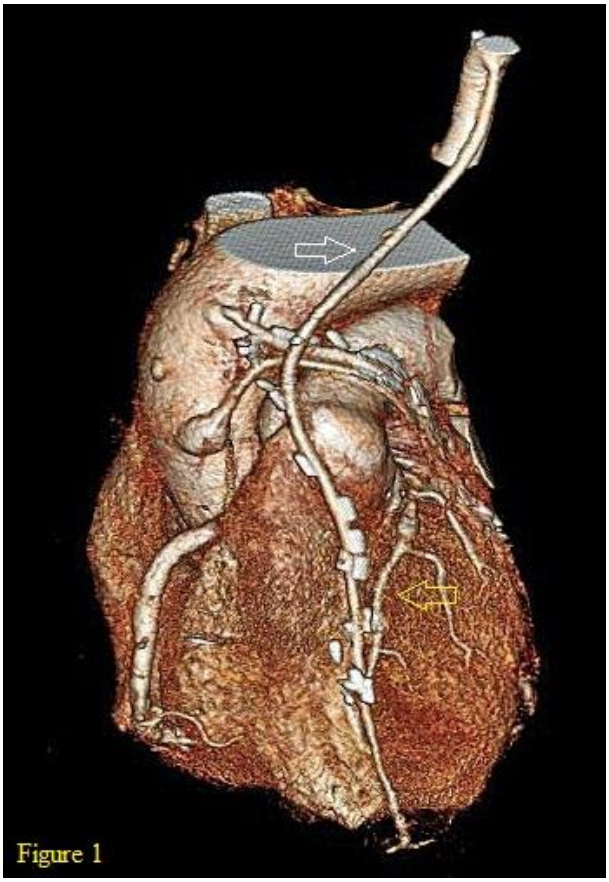

Figure 1: LIMA-LAD anastamosis is shown. White arrow is poited out LIMA, yellow arrow is pointed out LAD

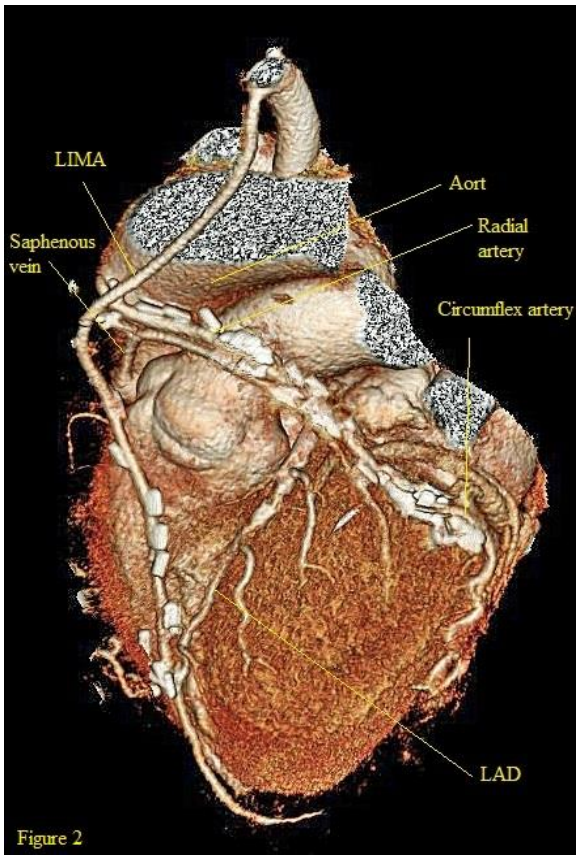

Figure 2: All anastamosis including saphenous-vein, radial artery, LIMA are shown.

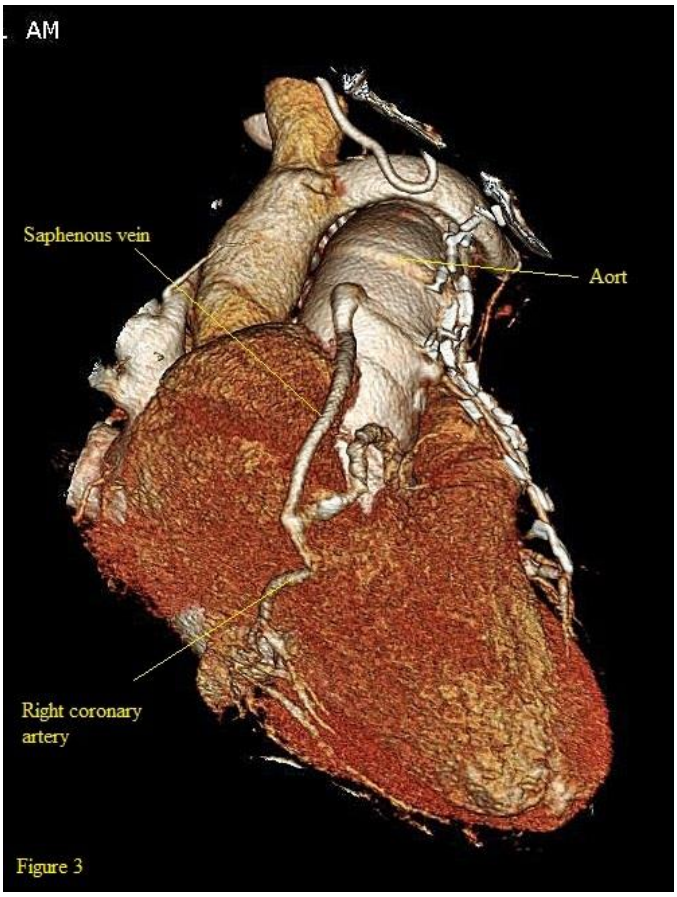

Figure 3: Right coronary artery anastamosis with saphen vein is shown.

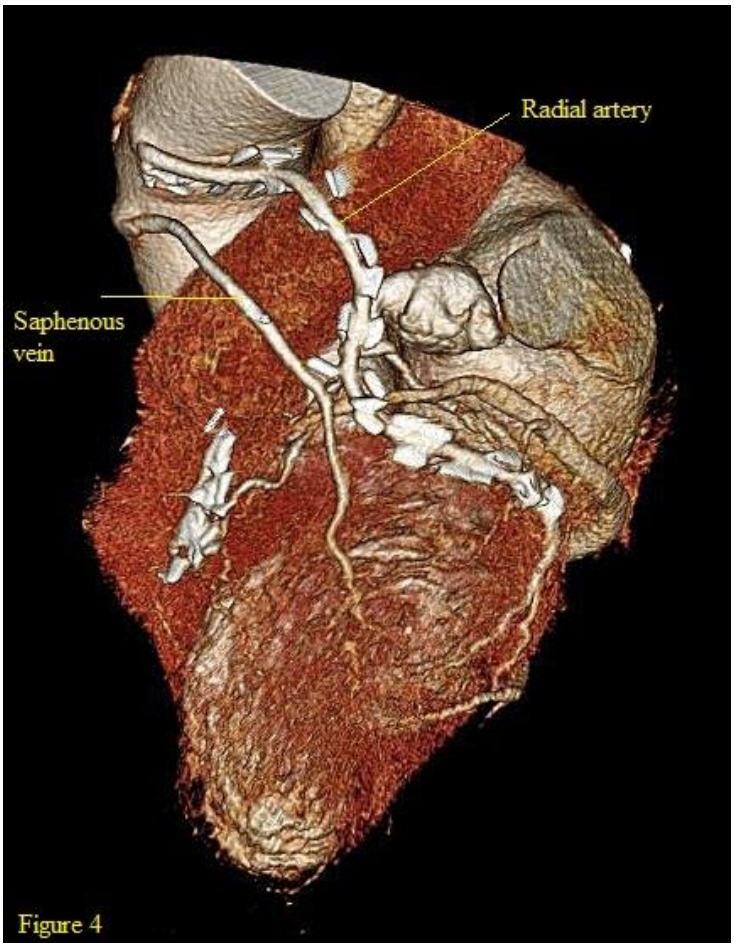

Figure 4: Circumflex artery anastamosis with radial artery and The branch of LAD anastamosis with saphenous-vein are shown.