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ON-PUMP VERSUS OFF-PUMP CORONARY ARTERY BYPASS GRAFTING IN PATIENTS WITHMULTI-VESSEL DISEASE

By

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ABSTRACT

Background: The performance of coronary bypass surgery without cardiopulmonary bypass ("off pump") may reduce perioperative morbidity and costs, but it is uncertain whether the outcome is similar to that involving the use of cardiopulmonary bypass ("on pump"). In fact, the advantage of using off-pump myocardial revascularization is being documented in high risk subgroups.

Objective: The purpose of this study was to compare on-pump versus off-pump myocardial revascularization in patients with multi-vessels disease.

Patients and Methods: Sixty patients with multi-vessel disease requiring CABG surgery at a single institution were prospectively randomized to have the procedure performed with on pump(group A, n=30) or with off pump (group B, n=30). Different preoperative, operative, postoperative variables and six month follow up were evaluated among both groups.

Results: There was no statistical difference between the two groups preoperatively regarding their age, sex, comorbidities (except emergency patients, which was significantly higher in group "B") and left ventricular function. Regarding intraoperative comparison, there was no significant difference in the total number of grafts. There was a significant difference in the intensive care parameters. The mechanical ventilation time was significantly shorter in group "B", and the blood transfusion required was significantly less in group "B". The ICU stay was significantly shorter in group "B".Left ventricular functions significantly decreased immediately and one week follow up postoperative, but backed up again after six months postoperative follow up in both groups. However, there was no statistically significant difference between both groups.The postoperative complications showed no statistically significant difference between both groups.The total hospital stay was significantly higher in group "A".

Conclusions: Both on-pump and off-pump procedures usually result in excellent outcomes, but should be judged to choose the better from both techniques to every patient according to clinical condition of the patient, center equipment and surgeon experience.

INTRODUCTION

The gold standard for multivessel coronary revascularization continues to be coronary artery bypass grafting (CABG). Despite advances in percutaneous coronary intervention (PCI) and medical therapy, CABG still plays a major role in the treatment of patients with coronary disease***(Polomsky and Puskas, 2012)***.

There is a debate continues between on-pump and off-pump approach for coronary artery bypass grafting. Conventional coronary artery bypass grafting is performed with cardio-pulmonary bypass, which is associated with serious complications such as stroke, renal dysfunction, and systemic inflammatory response syndrome **(Lattouf et al., 2008).**

Off-pump coronary artery bypass (OPCAB) surgery has been demonstrated to have a comparable risk-adjusted mortality and to be associated with less major complications. Current data suggest that off-pump coronary artery bypass surgery may be superior for most patients **(Puskas et al., 2009).** The most common complications of CABG are postoperative bleeding, low cardiac output syndrome, postoperative renal dysfunction, neurological events, atrial arrhythmias, and deep sternal wound infection which may be less in OPCAB **(Foote et al., 2011).**

Outcome of off-pump coronary artery bypass surgery is largely dependent on the cardiac surgery team in selecting team members, well equipped hospital and candidate cases. In the early learning curve of OPCAB, it is recommended to start with less complex cases (primary, elective, normal left ventricular function "LVF", anterior epicardial vessels with focal rather than diffuse lesion and limited graft number) as the first case on the operative list **(Dewey and Mack, 2008).**

No technique was found perfect to be applied to all patients. Nowadays, we are confronted with different categories of patients varying from straight forward low risk cases to complicated ones due to the increase in number of elderly patients with complicated coronary anatomy and impaired left ventricular function. The use of both conventional cardiopulmonary bypass and off-pump among patients with impaired LVF proved its efficiency and safety ***(Darwazah et al., 2006).*** Under certain circumstances, the application of both techniques could not be possible and even harmful to the myocardium ***(Darwazah et al., 2010).***

The purpose of this studywas to investigate the safety and efficacy of multivessel revascularization and to compare off-pump with on-pump techniques.

PATIENTS AND METHODS

Patients: Sixty patients undergoing CABG for multiple vessel disease. The study was done at the Cardio-thoracic Surgery Department, AL- Hussein University Hospital, AL-Azhar University, during the period between June 2012 and January 2014.Informed consent was obtained from all patients.

Inclusion Criteria: Patients with coronary multi-vessel disease (two vessels or more) and patients with any ejection fraction.

The patients were divided into two equal groups: Group "A" underwent on-pump CABG and group "B"underwent off-pump CABG.

The decision to perform on-pump or off-pump CABG depended on hemodynamic status at anesthetic induction. Patients with hemodynamic stable at anesthetic induction were treated by off-pump technique, while the patients with hemodynamic instability were treated by on-pump technique. Patients who had clinically significant preoperative hepatic or renal dysfunction, thrombocytopenia, and coagulopathy, redo, associated another cardiac lesions, recent myocardial infarction or uncontrolled arrhythmia, and converted from off-pump to on-pump were excluded. Pre-,intra- and postoperative data were collected for each patient in both groups. All survivors were subjected to six-month follow-up assessment. Patients in both groups were matched for demographic data includingage, sex, and history of previous myocardial infarction and risk factors of ischemic heart disease.

Preoperative parameters: Patients were subjected to history taking, clinical examination, laboratory investigations, electrocardiogram (ECG), plain chest X-ray, echocardiography and coronary angiography.

Anesthesia: Cardiac medications were continued until the morning of the surgery and beta-blockers were not used during the intervention. All patients were pre-medicated by 0.01 mg/kg of intramuscular morphine 1 hour before operation. In the operating room, a radial arterial catheter was inserted under local anesthesia, a 7F triple-lumen central venous catheter was inserted into the right internal jugular vein, and a femoral arterial catheter was inserted under general anesthesia to facilitate intra- aortic balloon pump (IABP) insertion if needed. After a 5-lead electro-cardiogram, SpO2, bispectral index and invasive arterial pressure monitoring, anesthesia was induced with 0.1 mg/kg of intravenous midazolam, 5 ug/kg of intravenous fentanyl, and 0.3mg/kg of intravenous cisatracuriume to facilitate endotracheal intubation. Ventilation was then started with an FIO2 of 50% to maintain normocapnia. Nasopharyngeal temperature, urine output, heart rate, and blood pressure were monitored throughout the procedure. Anesthesia was maintained with propofol infusion (1mg/kg/hr) and isofluoran was adjusted to keep the bispectral index level between 40 and 60. Intravenous fentanyl infusion was 2 ug/kg/h, and cisatracuriume infusion was 0.15mg/kg. At the end of surgery, cisatracuriume and fentanyl were stopped, and the patient was shifted to intensive care unit with sedation of 1 mg/kg/hour of propofol infusion.

Operative: The heart was exposed through a median sternotomy. The left internal mammary artery and great saphenous vein were used in all patients. All patients had complete revascularization with two techniques:

In group (A), heparin was given (300 U/Kg), and cardiopulmonary bypass (CPB) was established with ascending aorta and two-stage venous cannulation using moderate hypothermia (28-32°C), a centrifugal pump, and uncoated tubing system with membrane oxygenator. Myocardial protection was achieved using antegrade cold blood cardioplegia. Intraoperative heparin monitoring was by standard activated clotting time (ACT). Additional heparin boluses (5000 U) were given if the ACT values were less than 400 seconds. Protamine sulfate was administered to reverse heparin. Cardiopulmonary bypass was used at a flow rate of 3.5 – 5.0 L/min. Mean arterialpressure was maintained at 60-85 mmHg by adjusting blood flow rate. Infusion of cold blood cardioplegia was done immediately after cross clamping. The cold blood cardioplegia solution was formed of potassium chloride (20 mEq/L), lidocaine (100 mg/L) and sodium bicarbonate (20 mEq/L). The route of delivery was exclusively antegrade. The temperature of cardioplegia ranged from4 to 6 °C. The first dose of cardioplegia solution was infused over 4 minutes with the same infusion rate (150-200 ml/min) and repeated every 30 minutes with half dose at the same rate of perfusion**.** After completion of all distal anastomosis, the aortic clamp was released and proximal anastomosis to the ascending aorta was completed within a single aortic partial side-bite clamping. After hemodynamic stability was obtained, weaning started from CPB, but may need to increase intropic support or use of intra aortic balloon pump (IABP) if hemodynamic instability persisted. Routine hemostasis and closure were performed after hemodynamic stability was obtained.

In group (B), some precautions to the patients with off-pump were taken to keep the patient warm by keeping the temperature of the operating room above 25 °C and all fluids were warmed. Patients were also warmed with warm mattress, during the period of heart displacement. Ringer lactate was infused at a fixed rate of 8 ml/kg/h, and the amount of blood lost was replaced by an infusion of colloid solution or blood guided by hematocrit level. In case of hypotension, epinephrine and or norepinephrine were given to maintain mean systemic arterial pressure (MAP) above 60 m mHg.The heart was exposed through a median sternotomy and suspended in a pericardial cradle. After the dissection of left internal mammary artery (LIMA), 2 mg/kg of intravenous heparin was injected to keep activated clotting time over 250 seconds during the anastomosis. During the period of heart displacement and grafting, a mean systemic arterial pressure (MAP) was maintained above 60 mmHg using either a trendelenberg position or a norepinephrine infusion. When severe hypotension was observed (MAP drop below 40 mmHg), the manipulations were immediately interrupted and the heart was placed in the normal position. Also, it may need to increase intropic support or use of intra aortic balloon pump (IABP)if hemodynamic instability persists. Once the patient's hemodynamic returned to the physiological value, the stabilization was again attempted by modifying the stabilizer position and the heart mobilization in order to minimize hemodynamic disturbances. Nitroglycerin infusion was initiated whenever signs of ischemia were detected on continuous ECG monitoring. The heart was displaced using posterior pericardial stay suture which was placed between atrioventri-culargroove and left inferior pulmonary vein. Large gauze (12-70 cm) swab and tissue stabilizer (Octopus Tissue Stabilization System, Medtronic Inc.USA) were applied to reduce cardiac motion in the coronary territory with gentle compression on the beating heart. The sequence of grafting was always the left internal mammary artery to left anterior descending coronary artery (LAD) first, followed by grafting on the obtuse marginal, ramus or diagonal, and the right coronary artery. The coronary blood flow was interrupted using circling silastic band proximally to the arteriotomy site. Coronary anastomosis was performed under direct visualization using air source to clean the site of anastomosis. For surgical access to the OM and posterior branches, the apex of the heart was displaced towards the head of the patient. The table was set in the Trendelenburg position and rotated sideway to the right of the patient (20–30^{o}). Tension was applied to the stay suture in order to bring out the apex which should be pointed up at 90^o out of the wound and two large gauze swabs were put posterior to the heart. LAD and diagonal coronaries exposure used the same settings except the traction on the stay suture, and the side rotation was not necessary. Stabilization of the PDA was obtained by setting the table in the Trendelenburg position, and by exteriorization of the apex. The left internal thoracic artery was used to bypass the LAD in all patients, while the saphenous vein was used to bypass the other territories. Proximal anastomosis to the ascending aorta was completed within a single aortic partial side-bite clamping. After hemodynamic stability was obtained, routine homeostasis and closure was done.

The following operative data were collected in all patients: Number of grafts performed, operative time, use of inotropic support and use of intra-aortic balloon pump.

Postoperative data included: ICU stay, duration of ventilatory support, mortality and morbidity, period of hospital stay and echocardiography to assess left ventricular dimension and ejection fraction.

Follow-up: All patients were subjected to clinical assessment and echocardiography at our patient clinic after 6 months.

STATISTICAL ANALYSIS: Statistical Package of social science (SPSS) version 9.0 was used for analysis of data. Data was summarized as mean ± SD. T-test was used for analysis of two quantitative variables. One way ANOVA was used for analysis of more than two variables. Chi Square test or Fisher's test was used for analysis of qualitative data. Statistical significance was accepted at a P values were equal to or less than 0.05.

RESULTS

No statistical significant difference in two groups according to age, sex, left ventricular ejection fraction and risk factors, except emergency cases, showed statistical significant difference in two groups as there was 13%in group B (Table 1).

Table (1): Preoperative characteristics of the two groups of patients.

Groups / Characteristics	Group A **(n= 30)**	Group B **(n= 30)**	P-value
Age (years) (Mean ± SD)	51.8 ± 7.91	54.9 ± 7.95	>0.05
Sex (M\F)	25\5	20\10	>0.05
Risk factors			
Obesity (%)	7	7	>0.05
Smoking (%)	43	47	>0.05
Diabetes mellitus (%)	53	30	>0.05
Dyslipidemia (%)	17	30	>0.05
Hypertension (%)	73	53	>0.05
Previous myocardial infarction (%)	33	37	>0.05
Emergency (%)	0	13	0.01
Echo (Mean ± SD)			
Left ventricular ejection fraction (LVEF)	61.6 ± 10.9	59.6 ± 9.9	>0.05

As regard preoperative total number of grafts in the two studied groups listed in table (2) there was no statistical significant difference in two groups (Table 2).

Table (2): Total number of grafts in the two groups

Characteristics \ Groups	Group A **(n= 30)**	Group B **(n= 30)**	P-value
4 grafts	1 (4%)	3 (10%)	>0.05
3 grafts	10 (33%)	8 (27%)	>0.05
2 grafts	19 (63%)	19 (63%)	>0.05
Total no. of grafts	72	74	--

In the postoperative data, there was no significant difference between the two groups in postoperative complications and blood loss. The ventilation time, blood transfusion, ICU stay and hospital stay were more among group A with significant difference (Table 3).

Table (3): Postoperative characteristics of the two groups of patients

Characteristics \ Groups	Group A **(n= 30)**	Group B **(n= 30)**	P-value
Intensive care unit (ICU) data (Mean ± SD)			
Ventilation time(hours)	18.3 ± 7.7	10.9 ± 6.4	<0.001
Blood loss (ml)	468 ± 233	558 ± 201	>0.05
Blood transfusion (ml)	1266 ± 409	983 ± 404	<0.009
ICU stay (days)	3.2 ± 1.2	2.6 ± 0.6	<0.017
Complications			
MI (%)	17	7	
Atrial arrhythmia (%)	17	13	
Ventricular arrhythmia (%)	17	10	>0.05
Stroke (%)	0	3	
Renal insufficiency (%)	20	10	
Liver enzymes (%)	40	23	
Hospital stay (Mean ± SD)	11.4 ± 3.2	9.6 ± 1.81	<0.01

No statistical significant difference in two groups as regard post-operative ejection fraction as shown in table (4).

Table (4): Postoperative ejection fractions in the two groups of patients

Characteristics \ Groups	Group A **(n= 30)**	Group B **(n= 30)**	P-value
Immediate postoperative(Mean ± SD)	55.3±9.2	51.8±8.7	> 0.05
One week postoperative(Mean ± SD)	56.1±9.2	53.8±8.1	> 0.05
6 months postoperative(Mean ± SD)	60.6±9.9	61.3±9.1	> 0.05

The evaluation of pre-operative and post-operative ejection fraction in patients in group "A" showed that mean values of ejection fraction immediate post-operative decrease in relation to pre-operative mean values with statistically significant difference between them.The mean values of ejection fraction one week post-operative showedslight increase in relation to immediate post-operative mean values but still smaller than pre-operative mean values with statistically significant difference between them. The mean values of ejection fraction six months post-operative increased in relation to immediate post-operative mean values and one week post-operative mean values, but there were slight difference in ejection fraction mean values between pre-operatively and six months post-operative with no statistically significant difference between them (Table 5).

Table (5): Preoperative and postoperative ejection fraction in group "A"

Variables	**Mean ± SD**	**P value**
Preoperative	61.6 ± 10.9%	--
Immediate postoperative	55.3 ± 9.2%	<0.01
One week postoperative	56.1±9.2%	<0.01
6 months postoperative	60.6±9.9%	> 0.05

The evaluation of pre-operative and post-operative ejection fraction in patients in group B showed that mean values of ejection fraction post-operatively decreased in relation to pre-operative mean values with statistically significant difference between them. The mean values of ejection fraction one week post-operative slight increase in relation to immediate post-operative mean values but still smaller than pre-operative mean values with statistically significant difference between them. The mean values of ejection fraction six months post-operatively increased in relation to immediate post-operative mean values, and also increased in relation to one week post-operatively mean values, but there were increase in ejection fraction mean values from pre-operatively to six months post-operatively with no statistically significant difference between them (Table 6).

Table (6): Preoperative and postoperative ejection fraction in group "B"

Variables	Mean ± SD	P value
Preoperative	59.6 ± 9.9%	--
Immediate postoperative	51.8±8.7%	<0.01
One week postoperative	53.8±8.1%	<0.01
6 months postoperative	61.3±9.1%	> 0.05

DISCUSSION

Surgical myocardial revascularization has increasingly been used to successfully restore nutrient blood flow to areas of ischemic myocardium with lasting effects. Improvements in surgical technique during the past 3 decades have led to expanded indications for surgical revascularization to include a growing number of high risk subgroups, including women and patients with a low EF **(Keeling et al., 2013).**

On-pump coronary artery bypass grafting technique was the standard method of treatment for ischemic heart disease patients because it allows working in a quiet and bloodless environment to perform the anastomosis. Left ventricular function is an essential prognosis determiner in coronary artery surgery. Studies denoted that the results of coronary artery surgery performed without cardiopulmonary bypass (CPB) in high risk patients who have left ventricular dysfunction is better than the results of on-pump group. Although it is hard to work on a beating heart, off-pump bypass surgery has important benefits especially it does not have the inflammatory, neurologic and renal effects of CPB. The requirement of blood transfusion and extended ventilator support are less in this technique. So, the related complications are few **(Keeling et al., 2013).**

Preoperative evaluation: In this study, the mean age in both groups was relatively younger than the age groups in other studies. **Filardo et al. (2011)** and **Keeling et al. (2013)**stated that the mean age was above 60 years. The younger mean age in our study may be attributed to higher risk factors, especially smoking, dyslipidemia and sedentary life style, which are common in most developing countries including Egypt.

Houlind et al. (2014) reported that, in ONCAB group, 16% of patients were diabetic, 70% were hypertensive, 46% had a history of myocardial infarction and 22% were obese. In OPCAB group, 22% of patients were diabetic, 68% were hypertensive, 42% had a history of myocardial infarction, and 20% were obese. There was no statistical significance regarding the comorbidities which was nearly similar to our studies. **Dalén et al. (2013)** keeps risk factors in both groups constant.

Houlind et al. (2014) reported that in ONCAB group, 70% of the patients had an ejection fraction more than 50%, 25% of the patients had an ejection fraction between 30%-50%, and 6% of the patients had an ejection fraction less than 30%. In OPCAB group, 73% of the patients had an ejection fraction more than 50%, 23% of the patients had an ejection fraction between30%-50%, and 5%) of the patients had an ejection fraction less than 30%which was nearly similar to **Dalén, et al. (2013).** In our study, the preoperative LVEF in ONCAB group was 61.6 ± 10.9,andin OPCAB group was 59.6 ± 9.9 with no significant difference between two groups

Dalén et al. (2013) stated that the use of internal mammary artery was only in 93%of patients of both groups. The average number of grafts in ONCAB patients was equal to 3.5 grafts, and the average number of grafts in OPCAB was equal to 2.0 grafts which slightly higher in group "A" than our study and slightly lower in group "B" than current study. **Elmistekawy et al. (2012)** reported that the mean number of grafts in ONCAB group is 2.8 ± 0.6, while in OPCAB group; the mean number of grafts is 2.2 ± 0.7, which is nearly similar to our studies.

Renner et al. (2013) reported that the postoperative mechanical ventilation ranged from 7.5–14.7 hours with a mean of 9.9 hours in ONCAB group. In OPCAB group, the ventilation time was highly significantly lower and ranged from 6.2–11.9 with a mean of 8.4 hours. This shows that the mean of postoperative mechanical ventilation is shorter than that of our study. This may be due to wide range and numbers of patients.

In the present study the blood transfusion in ONCAB group was more than in OPCAB group. This was most probably because OPCAB were not exposed to the big amounts of fluids used to prime the CPB circuit, which in turn led to more hemodilution, which required blood transfusion to correct this hemodilution. Also, the impact of CPB to the coagulation factors caused coagulopathy which increased the amount of blood drainage, hence the need for more blood transfusion. **Dalén et al.(2013)** and **Keeling et al. (2013)** donot mention the amount of postoperative bleeding or postoperative need of transfusion, but give direct interest towards percentage of patients required re-exploration.

Renner et al. (2013) calculated period of ICU in hours and reported that total intensive care unit stay in ONCAB group ranged from 19-72 hours, with a mean of 25 hours, while in OPCAB group, the range was 18-38 hours, with a mean of22 hours with no statistically significant difference, but relatively shorter than in our study. The reason why we had longer ICU stay in our study is that we do not discharge patients from the ICU before removal of the retrosternal and chest tubes.

The comparative study between ejection fraction in preoperative, postoperative and follow up of two groups of patients reported that there was high significant difference between the preoperative and postoperative of two groups, and between the preoperative and follow up of two groups.However, there was no significant difference between the postoperative and follow up of two groups of patients.

La Par et al. (2011) reported that 0.3% of patients in ONCAB group, and 1.2% of patients in OPCAB group developed acute myocardial infarction. **Keeling et al. (2013)** reported that 0.7% of patients in ONCAB group, and 0.4% in OPCAB group developed acute myocardial infarction. **Renner et al. (2013)** reported that 1.8% of patients in ONCAB group, and 1.4% of patients in OPCAB group developed acute myocardial infarction. In these studies, there were significant difference between the two groups, but in our study, no significant difference was found between the two groups due to smaller numbers of patients than in other studies.

Li et al. (2014) reported that 21.7% of patients in ONCAB group and 20.9% of patients in OPCAB group developed post-operative atrial fibrillation (AF), and controlled by intra-venous infusion of Amiodarone. This shows that number of patients developed post-operative atrial fibrillation in this study is larger than in our study.

Dalén et al. (2013) reported that 4.6% of patients in ONCAB group, and 10% of patients in OPCAB group developed post-operative stroke. This shows that the percentage of stroke in ONCAB patients is less than that in OPCAB patients which like our study.

La Par et al. (2011)reported that 2.6% of patients in ONCAB group, and 1.7% of patients in OPCAB group developed post-operative stroke which is larger than our study in group "A", but smaller than our study in group "B".

Li et al. (2014) reported that 2.7% of patients in ONCAB group, and 2.5% of patients in OPCAB group developed post-operative acute renal failure, which is smaller than in our study, but 1.0% of patients in ONCAB group, and 0.9% of patients in OPCAB group need hemodialysis, which was not like our study as no patient need hemodialysis.

Keeling et al. (2013) reported that mean length of hospital stay was 8.8 ± 7.6 days in ONCAB group, while it was 8.2 ± 7.2 days in OPCAB group, which is shorter than in our study also due to larger number of patients than in current study.

Renner et al. (2013) study reported that the range of hospital stay was 11-15 days in ONCAB group, while it was 10-14 days in OPCAB group, which is longer than that of this study.

CONCLUSION

The on-pump and off-pump procedures usually result in excellent outcomes. It should be judged to choose the better from both techniques to every patient according to clinical condition of the patient and center equipment. The most important factor is surgeon experience as selection of the technique of operation to the single patient is probably the way to improve the postoperative outcome.

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خلفية البحث: إن عملية زرع الشرايين التاجية للقلب بطريقة القلب النابض يساهم فى تقليل نسبة حدوث المضاعفات والتكلفة ولكن لم يثبت أن التحسن يتساوى بمثل ما يتحسن عند إجراء العملية باستخدام ماكينة القلب الصناعى. فى الحقيقة ان ميزة استخدام طريقة القلب النابض فى زرع الشرايين التاجية مثبت فى المجموعات ذات الخطورة العالية.

الهدف من البحث :مقارنة طريقة القلب النابض بطريقة ماكينة القلب الصناعى فى زرع الشرايين التاجية.

المرضى وطرق البحث : شملت هذه الدراسة ستين مريضا مصابين بقصور في الشرايين التاجية والذين يحتاجون إلى إجراء جراحة لترقيع الشرايين التاجية ، وقد خضع ثلاثون مريضا للجراحة باستخدام ماكينة القلب الصناعي(مجموعة أ) ، في حين خضع ثلاثون مريضا للجراحة باستخدام طريقة القلب النابض(مجموعة ب) ،وقد جرى تقييم لمختلف المتغيرات قبل الجراحة وأثناء الجراحة وأيضا ما بعد الجراحة وستة أشهر متابعة بعد الجراحة للمجموعتين.

النتائج: لا يوجد فرق بين المجموعتين بالنسبة لمختلف المتغيرات مثل النوع والسن ووظيفة البطين الأيسر وعوامل الخطورة قبل إجراء الجراحة ما عدا نسبة الحالات الطارئة فكانت اعلى فى المجموعة ب ، وأيضا لا يوجد فرق بين المجموعتين بالنسبة للمتغيرات أثناء إجراء الجراحة بالنسبة لمتوسط عدد الشرايين التي تم زرعها لكل مريض. يوجد فرق كبير فى المتغيرات أثناء فترة البقاء في الرعاية المركزة . ففترة استخدام جهاز التنفس الصناعي والحاجة إلى نقل الدم بعد إجراء الجراحة وفترة البقاء في الرعاية المركزة كانت أقل نسبيا في المجموعة ب.أما بالنسبة لوظيفة البطين الأيسر فقد قلت نسبيا بعد الجراحة مباشرة وبعد أسبوع من إجراء الجراحة مقارنة بها قبل إجراء الجراحة في المجموعتين، ولكنها تحسنت بعد ستة أشهر من إجراء الجراحة في المجموعتين لتصبح قريبة مع ما كانت عليه قبل إجراء الجراحة ، ولكن لم يكن هناك فرق في وظيفة البطين الأيسر بين المجموعتين.ولم يكن هناك فرق واضح بين المجموعتين بالنسبة للمضاعفات التي تحدث بعد إجراء جراحة ترقيع الشرايين التاجية ، وكانت فترة البقاء فى المستشفى أكثر نسبيا في المجموعة أ.

الإستنتاج: نستنتج من هذه الدراسة أن كلتا الطريقتين كانت لهما نتائج جيدة ومتقاربة في ترقيع الشرايين التاجية في مرضى قصور الشرايين التاجية، ولكي تعطي كلتا الطريقتين النتائج المرجوة منها لابد من الأخذ في الاعتبار حالة المريض، وخبرة الجراح وأيضا إمكانيات مركز الجراحة ، وذلك في كلا الطريقتين.