

Data analysis

## Early clinical outcomes of on-pump versus off-pump coronary artery bypass grafting in patients with triple vessel disease

Mohammad Sharif Popal<sup>1</sup>, Zhiyong Liu<sup>2\*</sup>

<sup>1</sup>School of Medicines, Southeast University, 210009, Nanjing, China

<sup>2</sup>Department of Cardiothoracic Surgery, Zhongda Hospital, Southeast University, 210009, Nanjing, China

### Abstract

Cardiovascular disease is the main cause of morbidity and mortality in cardiac patients. Coronary artery bypass grafting (CABG) is the surgical procedure performed by cardiac surgeons worldwide. This study was designed to illustrate a comparison of early clinical outcomes of on pump vs off pump CABG in patients with three vessel disease. Total number of subjects selected were (n=85). In group A, 30 subjects for on pump procedure and in group B, 55 subjects for the off pump procedures were selected. Exclusion criteria of subjects were included: emergency or urgent operations, combined valve surgery, history of renal insufficiency, stroke or transient ischemic attack, patients with atrial fibrillation, atrial flutter, and sustained ventricular tachyarrhythmia. Fourteen parameters were chosen for the evaluation of two procedures. The preoperative risk assessment was counted via parsonnet score system. The number of patients who experienced postoperative atrial fibrillation were 11 (11.94%) in total; 7 cases (23.3%) were related to on pump CABG group and 4 cases (7.3%) were related to off pump CABG group. The frequency of the recurrence of atrial fibrillation, which was  $2.9 \pm 1.1$  days overall; in the on pump CABG group was  $3.6 \pm 1.2$  days while in the off pump CABG group was  $2.2 \pm 0.9$ . The ICU stay in on pump group was  $2.3 \pm 3.7$  days, while for off pump group was  $1.1 \pm 0.4$  days. Meanwhile, duration of hospital stay was  $18 \pm 14$  days for the on pump group, whereas that was  $15 \pm 8.3$  days for the off pump CABG group. The conclusion revealed that there is no significant difference in early clinical outcomes of on pump vs off pump CABG in patients with triple vessel disease.

**Key words:** Bypass grafting, clinical outcomes, on pump vs off pump, parsonnet score system.

Received January 20, 2015 Revised March 24, 2015 Published online first April 25, 2015

\*Corresponding author Zhiyong Liu Email zylu@163.com



*To cite this manuscript:* Popal MS, Liu ZY. Early clinical outcomes of on-pump versus off-pump coronary artery bypass grafting in patients with triple vessel disease. Sci Lett 2015; 3(2):68-71.

### Introduction

Cardiovascular disease is the main cause of morbidity and mortality in cardiac patients. A coronary artery bypass graft (CABG) surgery is the most common surgical procedure performed by cardiac surgeons worldwide. The conventional method is on pump CABG and this type was reported in previous studies that the prognosis and angina relief outcome is better than off pump CABG procedure, however, many studies emphasized that on pump technique has postoperative complications which are avoidable in off pump technique beside that patients undergo the on pump CABG surgery have longer Hospital and ICU (intensive care unit) stay [1-3]. Coronary artery bypass grafting with cardiopulmonary bypass (CBP) leads to an acute stress response, intense and abrupt changes in the circulation [4, 5]. Male gender, old age, cardiac function, and low ejection fraction are the significant factors in resulting early complications ensuing off pump CABG. For example, atrial fibrillation (AF) is one of the most significant arrhythmia that occurs in CABG postoperatively on 2<sup>nd</sup> or 3<sup>rd</sup> day after the surgical procedure. Other postoperative CABG

complications are the followings: hemodynamic instability, pulmonary edema, heart failure, hypertension, organ failure, stroke, as well as an upsurge in treatment expenditure [6]. Previous studies reported that with an estimated prevalence of 42.5% in on pump vs 17.5% in off pump, atrial fibrillation (AF) is the most common postoperative complication in patients undergoing coronary artery bypass grafting, with a peak incidence between second to third postoperative days, meanwhile, postoperative atrial fibrillation was more prevalent in on-pump versus off-pump surgery (6.0% vs 3.0%,  $P=0.028$ ), it reveals that off pump CABG is a better therapeutic choice for patients to avoid postoperative atrial fibrillation (POAF) and prolonged hospital and ICU stay [1, 7]. Regarding that increase incidence rate of postoperative atrial fibrillation and morbidity in ICU and hospital stay ensuing CABG, unfortunately, it is causing an upsurge in postoperative treatment costs for the patients who undergoing on pump CABG without knowing the exact difference between the two surgical procedures. This study was designed to illustrate characteristics

of early clinical outcomes of on pump vs off pump CABG in patients with three vessel disease.

### Materials and methods

This clinical study was designed as a prospective cross sectional study and approved by the regional Cardiothoracic Surgery Research Center of Zhongda hospital affiliated to Southeast University, Nanjing, China. After submitting the written consent by the patients (n=85, on pump=30, off pump=55), they took part voluntarily for on pump versus off pump CABG surgery in the Cardiothoracic Surgery Department of Zhongda hospital in Nanjing, China from October 2012 to September 2014. All of the surgeries were performed by a specialized team while the team leader had more than 10 years of experience with CABGs. The patients were separated into two groups: In group A (n=30) on pump CABG was performed with hypothermic cardiopulmonary bypass and cold blood cardioplegic arrest and in group B (n=55) the patients underwent the off pump coronary artery bypass (OPCAB) surgery. The selection criteria was strictly designed and applied, the exclusion criteria included emergency or urgent operations, combined valve surgery, history of renal insufficiency (Cr>2 mg/dl), stroke or transient ischemic attack (TIA) within 30 days. Besides Patients with atrial fibrillation, atrial flutter, and sustained ventricular tachyarrhythmia were also excluded. Data collected includes age, gender, demographic variables, preoperative risk factors and early postoperative complications such as atrial fibrillation (AF), its frequency of recurrence, duration, bleeding, infection, vomiting, fever, heart failure, renal and respiratory dysfunctions all were recorded by medical trainees. Patients of both groups underwent Holter monitoring after ICU discharge during their hospital stay. The continuous variables are demonstrated as mean  $\pm$  standard deviation. For categorical variable analysis, including frequencies and percentages, two statistical tests were applied through PASW version 18, t-test and Chi-square test where the statistical significance was measured with P-values of  $\leq 0.05$ .

### Results

Total 85 patients with triple vessel disease undergone on pump (n=30) or off pump (n=55) coronary artery bypass grafting (CABG). The

average age in both groups was  $64.2 \pm 9.59$  years, while the male vs female ratio was 76.43% vs 23.57%. Prevalence of preoperative risk factors in all patients in both groups overall were; hypertension 71.8% (on pump 66.6%, off pump 74.5%), diabetes 28.2% (on pump 26.6%, off pump 29.1%), hyperlipidemia 25.9% (on pump 33.3%, off pump 21.8%), family history of coronary artery disease 4.7% (on pump 0%, off pump 7.3%), cigarette smoking 38.8% (on pump 26.6%, off pump 45.5%), meanwhile the average Parsonnet Score for on pump was 6.23, for off pump was 6.75, therefore, there were no significant differences between the two groups based on preoperative variables and Parsonnet score assessments. As revealed in the twin groups, both were balanced preoperatively regarding age, gender, diabetes mellitus, cigarette smoking, hypertension, hyperlipidemia, besides preoperative surgical assessment was conducted through Parsonnet score method. The number of patients who experienced postoperative atrial fibrillation (POAF) were 11 (11.94%) in total; 7 cases (23.3%) related to on pump CABG group and 4 cases (7.3%) related to off pump CABG group (P=0.07). The frequency of the recurrence of AF, which overall was  $2.9 \pm 1.1$  days; in the on pump CABG group was  $3.6 \pm 1.2$  days while in the off pump CABG group was  $2.2 \pm 0.9$  (P=0.03). This data illustrated that on pump CABG vs off pump CABG didn't have a significant difference in postoperative atrial fibrillation (OPAF) in patients with three vessel disease, but it revealed that on pump CABG could increase recurrence and the frequency of postoperative atrial fibrillation (POAF). Early postoperative complications are compared in the table Á. The ICU stay in on pump group was  $2.3 \pm 3.7$  days, while for off pump group was  $1.1 \pm 0.4$  days (P=0.025). Also the duration of hospital stay was  $18 \pm 14$  days for the on pump group while that was  $15 \pm 8.3$  days (P=0.234) for the off pump CABG group patients. Therefore, off pump CABG could significantly reduce the ICU stay compare to the on pump CABG but it was not significant for the hospital stay in patients of both groups with triple vessels disease. Postoperative heart failure was another parameter of significance which 6 cases recorded (7%) totally; 5 cases (16.6%) related to on pump CABG and 1 case (1.8%) related to off pump CABG (P=0.03). Once again the data regarding postoperative heart failure is in favor of off pump

**Table 1** Postoperative atrial fibrillation (POAF) and early complications after both type of surgeries.

Variables	On pump CABG (n=30)	Off pump CABG (n=55)	P-value
Occurrence of POAF [n (%)]	7 (23.3%)	4 (7.3%)	0.07
Recurrence of AF	3.6±1.2	2.2±0.9	0.03
Bleeding [n (%)]	6 (20%)	3 (5.4%)	NS
Infection [n (%)]	9 (30%)	9 (16.3%)	NS
Heart failure [n (%)]	5 (16.6%)	1 (1.8%)	0.03
Fever [n (%)]	11 (36.6%)	14 (25.5%)	0.02
Vomiting [n (%)]	3 (10%)	2 (3.6%)	NS
Resp. dysfunction [n (%)]	5 (16.6%)	5 (9%)	NS
Renal dysfunction [n (%)]	4 (13.3%)	1 (1.8%)	NS
ICU stay (day)	2.3±3.7	1.1±0.4	0.02
Hospital stay (day)	18±14	15±8.3	NS
Redo for bleeding [n (%)]	1 (3.3%)	1 (1.8%)	NS

NS: not significant; CABG = coronary artery bypass grafting; AF = atrial fibrillation; POAF = postoperative atrial fibrillation.

CABG. There was no incidence of postoperative mortality and stroke.

## Discussion

Cardiovascular disease is the main cause of morbidity and mortality in cardiac patients. Coronary artery bypass grafting is the surgical therapy for severe multi cardiovascular engrossment. Atrial fibrillation (AF) is one of the arrhythmias mostly reported in early clinical outcomes after the CABG procedure; meanwhile, AF is the leading reason of morbidity and mortality. Previously it was reported that there is a significant connection between postoperative AF and type of CABG and quality of postoperative management and monitoring [4-6]. Our study was designed to characterize comparison of early clinical outcome of on pump vs off pump CABG in patients with triple vessel disease. Our result showed that early clinical outcome of on pump vs off pump CABG in patients with triple vessel disease is nearly the same. Four out of fourteen parameters are in favor of off pump CABG while the rest ten are either the same or not important to mention. Comparison of atrial fibrillation (AF) was not significant in both groups and our finding is in line with two separate studies conducted by Place et al. [8] and Siebert et al. [9]. Recurrence of AF was significant and the result was better for off pump CABG and our result is in line with Mirhossini et al. [1]. Postoperative bleeding and infection were observed in both CABG procedures, but the result was not statistically significant, meanwhile, a study conducted by Forouzannia et al. also indicated that the difference regarding bleeding was not statistically significant [10]. Post CABG heart failure and fever were observed more often in CABG with CPB but less in off pump CABG and the difference was significant statistically. The other insignificant

parameters were; postoperative vomiting, renal dysfunction and respiratory dysfunction, which all revealed the same early clinical results in both on and off pump CABG groups, while our finding is in line with the following studies [1, 11, 13]. The ICU stay is another parameter which appeared favorable to the off pump CABG in our result and it is harmonized with a study conducted by Mirhosseini et al. [1]. The hospital stay was a parameter which in our result was not significant in both on and off pump surgical procedures, besides that our finding is in line with Davoodi et al. [12]. Redo for bleeding was observed two cases, one case in each group, but it was not significant. Stroke and mortality are the other two essential parameters which were not figured out in our findings and our result is the same in both groups. Previous studies also reported that stroke and mortality are the two parameters which were not different statistically [13, 14].

## Conclusions

In conclusion, the number of patients were small; however, the skills of our surgical team were good for performing the two types of CABGs with all positive results, and our strict criteria of the subject selection could be the probable causes of negative outcomes in our findings, but some parameters support the off pump CABG procedure whereas mostly illustrates insignificance statistically. More evaluations and studies along with a big number of patients in both groups can predict a better consequence for both groups.

## References

- [1] Mirhosseini SJ, Forouzannia SK, Ali-Hassan-Sayegh S, Hadad-Zadeh M, Abdollahi MH, Moshtaghiom H, et al. On pump versus off pump coronary artery bypass surgery in patients over seventy years old with triple vessels disease and severe left ventricle

- dysfunction: focus on early clinical outcomes. *Acta medica Iranica*. 2013;51(5):320-3.
- [2] Filardo G, Grayburn PA, Hamilton C, Hebler RF, Jr., Cooksey WB, Hamman B. Comparing long-term survival between patients undergoing off-pump and on-pump coronary artery bypass graft operations. *ATS*. 2011;92(2):571-7; discussion 7-8.
- [3] Sa MP, Ferraz PE, Escobar RR, Martins WN, Lustosa PC, Nunes Ede O, et al. Off-pump versus on-pump coronary artery bypass surgery: meta-analysis and meta-regression of 13,524 patients from randomized trials. *Revista brasileira de cirurgia cardiovascular : orgao oficial da Sociedade Brasileira de Cirurgia Cardiovascular*. 2012;27(4):631-41.
- [4] Bull DA, Neumayer LA, Stringham JC, Meldrum P, Affleck DG, Karwande SV. Coronary artery bypass grafting with cardiopulmonary bypass versus off-pump cardiopulmonary bypass grafting: does eliminating the pump reduce morbidity and cost? *The Annals of thoracic surgery*. 2001;71(1):170-3; discussion 3-5.
- [5] Angelini GD, Taylor FC, Reeves BC, Ascione R. Early and midterm outcome after off-pump and on-pump surgery in Beating Heart Against Cardioplegic Arrest Studies (BHACAS 1 and 2): a pooled analysis of two randomised controlled trials. *The Lancet*. 359(9313):1194-9.
- [6] Kalavrouziotis D, Buth KJ, Vyas T, Ali IS. Preoperative atrial fibrillation decreases event-free survival following cardiac surgery. *European journal of cardio-thoracic surgery : official journal of the European Association for Cardio-thoracic Surgery*. 2009;36(2):293-9.
- [7] Hashemzadeh K, Dehdilani M, Dehdilani M. Does Off-pump Coronary Artery Bypass Reduce the Prevalence of Atrial Fibrillation? *Journal of cardiovascular and thoracic research*. 2013;5(2):45-9.
- [8] Place DG, Peragallo RA, Carroll J, Cusimano RJ, Cheng DC. Postoperative atrial fibrillation: a comparison of off-pump coronary artery bypass surgery and conventional coronary artery bypass graft surgery. *Journal of cardiothoracic and vascular anesthesia*. 2002;16(2):144-8.
- [9] Siebert J, Anisimowicz L, Lango R, Rogowski J, Pawlaczyk R, Brzezinski M, et al. Atrial fibrillation after coronary artery bypass grafting: does the type of procedure influence the early postoperative incidence? *European journal of cardio-thoracic surgery : official journal of the European Association for Cardio-thoracic Surgery*. 2001;19(4):455-9.
- [10] Forouzannia SK, Abdollahi MH, Mirhosseini SJ, Hosseini H, Moshtaghion SH, Golzar A, et al. Clinical outcome and cost in patients with off-pump vs on-pump coronary artery bypass surgery. *Acta medica Iranica*. 2011;49(7):414-9.
- [11] Nezami N, Djavadzadegan H, Tabatabaie-Adl H, Hamdi A, Ghobadi K, Ghorashi S, et al. On-versus Off-Pump Coronary Artery Bypass Grafting: No Difference in Early Postoperative Kidney Function Based on TNF-alpha or C-Reactive Protein. *Cardiorenal medicine*. 2012;2(3):190-9.
- [12] Davoodi S, Karimi A, Ahmadi SH, Marzban M, Movahhedi N, Abbasi K, et al. Early outcome of off-pump versus on-pump coronary revascularization. *The Pan African medical journal*. 2014;17:309.
- [13] Lamy A, Devereaux PJ, Prabhakaran D, Taggart DP, Hu S, Paolasso E, et al. Off-pump or on-pump coronary-artery bypass grafting at 30 days. *The New England journal of medicine*. 2012;366(16):1489-97.
- [14] Chen YB, Shu J, Yang WT, Shi L, Guo XF, Wang FG, et al. Meta-analysis of randomized trials comparing the effectiveness of on-pump and off-pump coronary artery bypass. *Chinese medical journal*. 2012;125(2):338-44.