ORIGINAL PROF-750

(CCABG) Vs (OPCABG);

CONVENTIONAL CORONARY ARTERY BYPASS GRAFTING Vs OFF-PUMP CORONARY ARTERY BYPASS GRAFTING; COMPARISON OF POST OPERATIVE PARAMETERS

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A B S T R A C T

Objectives: The objectives of this study were to compare Off-pump CABG with Conventional CABG regarding; a). Duration of postoperative mechanical ventilation, b). Amount of postoperative bleeding, c). Volume of blood and blood product transfusions, d). Total stay in intensive care unit (ICU). Setting: Study was done at Post operative Intensive Care of a Tertiary Care Cardiac Hospital (AFIC/NIHD) Rawalpindi. Design & Methods: Study was a non interventional comparative study. Data were collected using a convenient sampling.The patients fulfilling the inclusion and exclusion criteria were selected as subjects. On compilation in tabulated form the results were analyzed using statistical program for social sciences (SPSS-8). Student's t Test was applied and significance was defined if p value was less than 0.05. Period: First forty two patients undergoing conventional CABG (CCABG) starting from 1st Jan 2001 onwards were included in group I and similarly first 42 patients undergoing Off pump CABG (OPCABG) from the same date were included in group II. Results: Patients in OPCABG group had significantly reduced time of mechanical ventilation and decreased bleeding thus requiring less number of blood and blood products units. OPCABG group also had significantly shorter stays in intensive care unit in comparison of CCAG. Conclusion: By avoiding cardiopulmonary bypass (CPB) circuit in selected patients we can reduce the duration of ventilation, total blood loss and thus blood product transfusions. Total stay in ICU post operatively could also be reduced.

Key words: Off-pump CABG, Conventional CABG, reduced blood loss, decreased use of blood and blood products and reduced ICU stay.

INTRODUCTION

Coronary artery bypass grafting (CABG), performed to alleviate circumvent blockages or stenosis in coronary arteries, have come a long way since the mid 1960s. It remains a major surgical procedure with significant complications, and continuous efforts have been made by all involved to reduce insult to organ systems of the patient. Although there has been a lot of improvement in cardiopulmonary bypass techniques in recent two decades, but the problems of neurological deficit, air embolism, coagulopathy, aortic dissection, pulmonary complications and renal morbidity still persist[1,2].

Pulmonary dysfunction is common after cardiopulmonary bypass (CPB). Lung injury is mediated in one or two ways, first , an inflammatory response due to leukocyte and complement activation, secondly a mechanical affect

culminating in surfactant loss, atelectasis with resultant ventilation to perfusion mismatch, loss of lung volumes and altered mechanics of breathing. Pulmonary functions show reduced static and dynamic compliance, reduced functional residual capacity and increased Alveolar-to-arterial gradient. Atelectasis and increased capillary leak due to haemodilution and hypothermic CPB are most likely etiologies[3].

This has compelled the cardiac surgeons around the world to perform coronary artery bypass surgery without the help of heart lung machine. The technique is known as off pump coronary artery bypass grafting (OPCABG). Unlike traditional CABG where the anaesthesiologist plays a relatively quiet role during the application of grafts on coronary arteries when the patient is on CPB, minute to minute involvement of anaesthesiologist is imperative for successful OPCABG . The continuous monitoring by anesthesiologist of cardiovascular functions, control of heart rate and blood pressure, viewing of segmental wall motion and continuation of it into post operative period is the key factor in attaining the goal of (when possible) facilitated recovery pathway in cardiac surgery. Early results are encouraging. A variety of patients have undergone OPCABG with comparable or lower morbidity/mortality, earlier extubation times, lesser intensive care unit and hospital stays, As the surgical techniques are becoming less invasive, if follows that the anaesthetic and post operative care of these patients should also become less invasive. An integrated multidisciplinary pathway can do this.

OBJECTIVES OF STUDY

To compare off-pump CABG with conventional CABG regarding;

a. Duration of postoperative mechanical ventilation
b. Amount of postoperative blood loss
c. Volume of blood and blood product transfusions.
d. Total stay in intensive care unit (ICU)

INCLUSION CRITERIA

- age = 30 - 70 years
- sex = male/female
- NYHA = 1 - 3 grade
- Disease = single, double or triple vessel CAD.

EXCLUSION CRITERIA

Patients with following problems/conditions were excluded from the study ;

- Diffuse coronary artery disease
- Diabetes mellitus
- COPD
- Emergency surgery and Redo Surgery

MATERIAL & METHODS

This was a non interventional comparative study carried out at AFIC/NIHD Rawalpindi. Data were collected suing convenient sampling and patients fulfilling the inclusion and exclusion criteria were selected as subjects. First forty two patients undergoing conventional CABG (CCABG) starting from 1st Jan 2001 onwards were included in group I and similarly first 42 patients undergoing off-pump CABG (OPCABG) from the same date were included in group II. On compilation in tabulated form the result were analyzed using statistical program for social sciences (SPSS - 8). Student's t Test was applied and significance was defined if p value was less than 0.05.

After the operation patient were shifted to ICU and following variables were monitored;

1. Duration of ventilation. It was measured from the time of shifting to ICU till the time of endotracheal extubation. Criteria observed for endotracheal extubation was as in table I.

2. Post operative bleeding was measured using following criteria;

   - Hourly bleeding
   - Total bleeding

3. Volume of blood and blood products used in ICU.

4. Total ICU stay. It was measured from the time of shifting from operation theatre till the time patient was shifted to post operative surgical ward. Criteria observed for shifting of patient from ICU was a in table II.

Table-I. Criteria For Endotracheal Extubation	
a	Post operative bleeding less than 1 ml/kg/hr.
b	No evidence of cardiac temponade or pleural effusion of X-Ray.
c	Arterial Blood Gases within normal limits on FiO_2 0.4.
d	Negative Inspiratory Pressure >15 cm of H_2O
e	Tidal volume > 7ml/kg.
f	Strong hand grip, Lifting of head on command
g	Core temperature 35-37°C
h	Peripheral temperature 33-36°C

RESULTS

In group I (CCABG) and in group II (OPCABG) mean duration of mechanical ventilation* in postoperative ICU was as in Table-III. Analysis showed a significant difference (p = 0.001) with less postoperative mechanical ventilation required in Off-pump CABG. Mean blood loss in ICU in group I and *in group II was as in Table 3. Significant difference (P = 0.006) in both groups was noted with less blood loss in OPCABG as compared conventional CABG. On analyzing the data of blood transfusion in two groups statistically significant difference (p= 0.023) was observed as in Table 3. Almost half the amount of blood was transfused in PCABG as compared to CCABG. Similarly difference in mean plasma volume transfused in group I and in group II was statistically significant as p = 0.007. Mean volume of platelets transfused in group I and in group II was significantly different (p = 0.034). Almost 1/3rd the volume of platelets transfused in OPCABG as compared to CCABG. A trend towards reduction in blood loss and blood transfusion requirements has been demonstrated in the OPCABG group in our study. (Table-III).

Table-II. Critera for Shifting of Patient from Icu	
a	Patient off inotropic support
b	Surgical drains are removed.
c	Afebrile or temperature<100°F.
d	No life threatening dysrrhythmias.
e	No neurological deficit.
f	Adequate renal function i.e., Urine output> 1 ml/kg/hr, Serum Creatinine< 1.5 mg/dl, Serum Urea not> 80mg/dl.
g	Cardiac functions: BP is 100 . 140 mm Hg Systolic; ECG shown no evidence of fresh ischemia

Table-III. Result & p - value (SPSS-8)

Parameters	Type of Operation	N	Mean	SD	SEM	P value
Time of Ventilation (hours)	on -pump CABG on-pump CABG	41 41	8.8314 5.8910	5.3263 1.5492	.8318 .2419	.001
Total blood loss (ml)	on -pump CABG on-pump CABG	41	582.51 460.20	262.17 209.71	40.94 32.75	.006
Total blood transfused in ICU (ml)	on -pump CABG on-pump CABG	41	284.15 142.68	239.12 207.23	37.34 32.36	.023
Total Plasma transfused in ICU (ml)	on -pump CABG on-pump CABG	41	73.17 42.68	121.50 87.01	18.98 13.59	.007
Total platelets transfused (ml)	on -pump CABG on-pump CABG	41	48.780 16.341	81.308 56.778	12.698 8.867	.034
Total time in ICU (hours)	on -pump CABG on-pump CABG	41	32.51 24.59	10.81 10.93	1.69 1.71	.001

Difference in mean duration of total stay in postoperative ICU in group I and in group II was also significant (P<0.05).

DISCUSSION

The whole-body inflammatory response has been attributed to cardiopulmonary bypass, with an increased morbidity risk that is potentially avoided by off-pump CABG.[4] This systemic inflammatory response begins with the activation of complement, both coaguolation pathways, and the fibrinolytic and kallikrein cascades. Monocytes adhere to the CPB circuit modulating the release of cytokines, i.e. TNF-a and a variety of interleukins, while the activation and degranulation of neutrophils results in the release of proteolytic enzymes and oxygen radicals culminating in end-organ injury and postoperative morbidity [5,6]. This complex set of interactions can have serious sequelae and have prompted physicians to seek improved patient management alternatives through less invasive procedures. Theoretically, by eliminating the use of cardiopulmonary bypass, many of the adverse systemic sequelae associated with extracorporeal circulation may be lessened. As important as documenting the benefit of OPCABG surgery is the need to confirm the safety of this technically demanding procedure by evaluation of clinical outcomes. Comparing these surgical outcomes along with the examination of recovery times, resources utilization and costs will hopefully provide an accurate answer to whether these new techniques are clinically beneficial to those patients requiring oronary bypass surgery.

We at AFIC/NIHD Rawalpindi are routinely performing OPCABG since 1998. Analysis of our data reveals that significantly less postoperative mechanical ventilatory support is required in Off-pump CABG.

For evaluation of our results were could not find any study at the national level so international studies are referred to. Our results were in concurrence with the international studies carried at other places. Kochamba and collegues[7] report on the pulmonary abnormalities seen in 58 patients randomized either to conventional CABG or to OPCABG and conclude statistically significant difference in intubation times (CCABG 9.24 hrs, vs. OPCABG 8.24 hrs). Arom et al[8] and Boyd et al[9] also noted significant reductions in time on mechanical ventilatory support previously. Kavarana, and his colleagues[10] obtained similar results in their study. This clinical data supports the hypothesis that avoiding CPB reduces the lung injury and helps in decreasing mechanical ventilation time in OPCABG surgery. These short ventilatory times also reduce the incidence of complications associated with prolonged mechanical ventilation and tracheal intubation.

While comparing the blood loss it was less in OPCABG as compared to conventional CABG and transfused blood volume in OPCABG was also half as compared to CCABG. Similarly volume of platelets transfused in OPCABG was almost. 1/3rd as compared to CCABG. Reduction in blood loss and blood transfusion is evident in OPCABG group in our study.

According to Puskas and his team[11] there was the reduction in the need for transfusion after the surgery. Less than a third of the off-pump patients (29.6 percent) needed transfusions compared to more than half (56.5 percent) of the CCABG group. Nader and his colleagues[12] compared in a study, use of blood and blood products in both groups and reported that there was significant decrease in blood product utilization offered by off-pump bypass techniques leading to concurrent decrease in the risk of transmitting blood -borne pathogens, blood transfusion reactions and the associated risk of homologous transfusion. They also reported that there is a decrease in bleeding with “off-pump” when compared to CPB. In a similar study kshettry VR, and colleagues[13] in a retrospective review of 744 patients undergoing multi-vessel coronary artery bypass between January 1, 1997, and March 31, 199 compared postoperative blood loss and use of blood transfusions and found a significant difference in two groups. (p,0.001). Kirk RC. Aldridge RA and associates[14] compared the performance of OPCAB with conventional bypass patients over the same 6-month period showed that OPCAB procedures resulted in significantly reduced mean postoperative ventilation hours (3.4 vs 8.3 hours), as compared to conventional bypass. There were significantly (p<0.05) fever blood transfusions in the OPCAB group (1.1 units vs 2.4 units), and the percentage of patients transfused blood was significantly less (34.9% vs. 57.3%).

All of the above-referred studies support the claim that by avoiding CBP we can avoid trauma to coagulation system as both coagulation factors and platelets are affected by the extracorporeal circuit. Platelet dysfunction and thrombocytopenia are found on and after CPB and platelet dysfunction is the most common cause of a bleeding problem following CPB after heparin is reveresed and surgical bleeding

is controlled. in OPCABG by avoiding CPB all of these hazardous effects are avoided. Our and other studies support this observation by showing reduced blood loss and reduced need of blood and blood products transfusion in OPCABG patients.

Our fourth parameter was comparison of total stay in postoperative ICU between two groups and this is very important parameter as by reducing the postoperative stay in ICU and hospital we can reduce the cost to the patient as well as resource utilization. On reviewing the international literature for similar studies we found that Kavarana et al[10] in their study also revealed a significantly shorter length of stay both in the ICU (2.0 = 4.0 days vs. 3.0 = 5.4 days; p = 0.0044) and postoperatively in the hospital (7.0 = 8.0 vs 9.0 = 10.0, p = 0.006). Antonio Maria calafiore, MD and colleagues[15] found that patients in the OPCABG group were discharged at an average of only 4.4 days and the maximum length of stay was only 10 days for the entire cohort. Buffolo and his associates[16] reported on their series 519 patients undergoing OPCAB with 3086 patients undergoing CCABG. Mortality was reduced 1,7% versus 3.8% and transfusion of blood products decreased 30% versus 55% and significantly reduced postoperative ICU stay. Calafiore [15] was able to demonstrate a decreased intensive care unit and hospital length of stay in OPCABG versus CCABG. John D. Puskas, MD[11] and his surgical team found that off-pump surgery also reduced the average postoperative hospital stay from 5.5 days to 3.3 days. In other study by the same group[17] it was observed that there was a reduction in length of stay by 3 days (p 0.01), blood transfusions by 50% (p = 0.0001), and hospital charges by one third (p = 0.05) in the off-pump group.

All these studies show similar results as this and ours supports the original hypothesis that by avoiding CPB we can reduce the collateral damage which may manifest as the post-perfusion syndrome.

This may include one or multiple clinical signs, such a pulmonary dysfunction, renal impairment, neurologic dysfunction, bleeding diathesis, increased susceptibility to infection, accumulation of interstitial duid, leukocytosis, fever, or haemolysis. Hence all or any of these effects can hamper patient's recovery or at least prolong postoperative stay in ICU and hospital, thus adding to the miseries of the patient clinically as well as financially.

CONCLUSION

We concluded from our data that by avoiding CPB, patients require reduced mechanical ventilatory support; blood loss is less with consequently reduced volume replacement. ICU stay is shortened postoperatively resulting in reducing total hospital stay. This reduces the cost to the patient as well as resource utilization. However prospective randomized trials with long-term follow-up are still required to evaluate long-term grft patency and to define the real benefits of this approach. Until the, although OPCABG has given us excellent early results it cannot be proclaimed as a salutary advance over CCABG. Further improvement in both anaesthetic and surgical techniques will make OPCABG applicable to an even greater spectrum of coronary artery disease and in future OPCABG may eliminate the need for CPB in most patients, stable or otherwise.

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The reward of a thing well done is to have done it.

Ralph Waldo Emerson