

OFF-PUMP BEATING HEART CORONARY ARTERY BYPASS SURGERY IN LOW-RISK PATIENTS: DOES IT REALLY ENHANCE EARLY RECOVERY?

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Off-pump coronary artery bypass (OPCAB) surgery is an established mode of revascularization in many cardiac centers. The avoidance of cardiopulmonary bypass surgery has obvious advantages in high-risk patients. In patients with poor left ventricular function, our recent study,¹ like others, has documented the superiority of this technique over conventional bypass surgery. The aim of this retrospective analysis was to identify the benefits of this OPCAB surgery in a low-risk group of patients in comparison to conventional coronary artery bypass technique in a similar group of patients, with regards to intensive care unit (ICU) length of stay and total hospitalization time. In the comparison of the two techniques, the study showed a marginal superiority of the off-pump technique, though no significant statistical differences were reached.

Materials and Methods

During a 32-month period ending in December 2000, a total of 282 patients underwent coronary artery bypass surgery using the off-pump technique. Of the total number, 200 were classified as low-risk, identified as patients with reasonable ventricular ejection fraction, good target vessels, and with no other comorbid factors. The total number of coronary artery bypass surgery cases during this period was 430.

The criteria for on-pump surgery in our institution over the last three years have changed as the center has gained more experience in OPCAB surgery. As of now, absolute contraindications to off-pump surgery in our center are diffusely diseased vessels, emergency surgery and oversized hearts with poor function needing posterior revascularization.

The off-pump cases were mainly done by our surgeon. The approach was a standard median sternotomy with full

pericardium between the right and left inferior pulmonary veins. Temporary occlusion of the vessel was achieved by using a 4/0 prolene suture. For the right coronary artery, an intra-arterial shunt was used if the vessel was big and the stenosis was less than 80%, as temporary occlusion of such a vessel can cause serious arrhythmias. No pharmacological stabilization was used, but a small dose of dopamine was needed in a few cases.

Results

There were 650 grafts using the off-pump technique, and these were predominantly in male patients. The demographic comparison between off-pump and the control group and the total number of grafts in each group are as shown in Tables 1 and 2. Although grafting of posterior vessels was extremely difficult initially in the off-pump group, with new techniques and instruments to visualize those vessels without hemodynamic compromise, the number of posterior vessels grafted in the group was comparable to the control group (Table 3). Comparison of independent risk factors between the two groups showed statistical significance only with regards to the size and quality of vessels grafted. This was expected, as we always try to avoid off-pump surgery for small or poor quality vessels (Table 4). The mean ICU time and the mean hospitalization time for both groups were also very similar (Table 5).

We used the Z-test for proportion drawn from one sample and two samples for statistical analysis.

Discussion

Many centers performing OPCAB surgery have published their early results documenting the feasibility of this technique and the theoretical benefits of eliminating cardiopulmonary bypass.² Although there is enough data supporting the superiority of this technique over conventional coronary artery bypass in some high-risk patients, such as those with severely impaired left

TABLE 1. Total number of patients and grafts in the two groups.

	Off pump	Control group	P-value
No. of patients	200 (52.6%)	180 (47.4%)	<0.3107
No. of grafts	650 (47.3%)	725 (52.7%)	<0.0452

TABLE 2. Demographic comparison between off-pump cases and control groups.

	Off pump	Control group	P-value
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heparinization. Mechanical stabilization was achieved by using the Octopus II and Octopus III (Medtronic) system. Exposure of the back of the heart was achieved by using a double-armed sling fixed in its midpoint to the posterior

Mean age	62	59	
Male patients	167 (83.5%)	155 (86.1%)	<0.4802

TABLE 3. Comparison between off-pump and on-pump regarding the frequency of posterior grafts.

	Off pump	On pump	P-value
Ramus intermediate	23 (43.4%)	30 (56.6%)	<0.3369
Obtuse marginal 1	51 (38.9%)	80 (61.1%)	<0.0102
Obtuse marginal 2	48 (44.86%)	59 (55.14%)	<0.2875
Posterior lateral	15 (41.67%)	21 (58.33%)	<0.3179
Posterior descending artery	62 (40.8%)	90 (59.2%)	<0.0224

TABLE 4. Risk factor comparison between off-pump and control groups.

	Off pump	On pump	P-value
Moderately impaired LV function EF35-50%	46 pts (23%)	45 pts (25%)	<0.6489
Target vessel <1.5 mm in diameter	97 grafts (15%)	217 grafts (30%)	<0.00001
Poor quality target vessel	24 pts (12%)	52 pts (29%)	<0.00001
Renal, respiratory or other illnesses	10 pts (5%)	13 pts (7%)	<0.4144

TABLE 5. Comparison of on-pump and off-pump cases regarding ICU time and total hospitalization time.

	Conventional	OPCAB	P-value
ICU time	mean=16 hours	mean=12 hours	<0.5031
Hospitalization time	mean=7 days	mean=5 days	<0.6802

ventricular function,^{3,4} there is still not enough evidence to support this technique over conventional bypass surgery in low-risk patients.

The systemic inflammatory response related to cardiopulmonary bypass was proven many years ago to lead to many complications, including bleeding due to platelet dysfunction, renal insufficiency and pulmonary insufficiency, all of which lead to a longer stay in the hospital.⁵ In general, cardiopulmonary bypass leaves patients feeling like they have been "hit by a truck," and their actual recovery can take weeks to months.⁶ However, with the new developments in conducting cardiopulmonary

bypass, surgeons in many centers worldwide are now able to fast-track their on-pump low-risk patients towards an average of 12 to 16 hours ICU time, and 4-5 days of total hospital time.

Our results failed to reach significant statistical difference between the two groups of patients, nevertheless, like others, we have seen over the last few years that off-pump patients do really recover somewhat faster than on-pump patients. This will only remain as an observation among surgeons doing off-pump surgery unless it can be supported with strong statistical evidence.

In order to properly identify the benefits of off-pump surgery in low-risk patients, cardiac centers practicing off-pump techniques need to seriously re-evaluate routine intraoperative and postoperative anesthesia and analgesia protocols for the off-pump patients. They also need to revise protocols for weaning these patients from artificial ventilation. Like others, we are continually conducting studies in that direction, and hope to provide substantive evidence on the superiority of the OPCAB technique in the near future.

In conclusion, off-pump coronary artery bypass surgery is a reasonable surgical alternative in the low-risk patient. Although there were no significant statistical differences between the two techniques, there is a reasonable feeling among off-pump surgeons of the superiority of OPCAB in enhancing earlier discharge and recovery for the low-risk patient undergoing this operation. Adjustment of routine patient management proposals for off-pump cases may prove this to be true in the future.

References

1. Fouda M. Beating heart coronary artery bypass for patients with poor left ventricular function and chronic stable angina: "a reasonable solution?" J Saudi Heart Assoc 2001;13:106-8.
2. Buffolo E, de Andrade JCS, Branco JNR, Teles CA, Aguiar LFA, Gomes WJ. Coronary artery bypass grafting without cardiopulmonary bypass (abstract). Ann Thorac Surg 1996;61:63-6.
3. Diegeler A, Matin M, Falk V, et al. Coronary bypass grafting without cardiopulmonary bypass: technical considerations, clinical results, and follow-up. Thorac Cardiovasc Surg 1999;47:14-8.
4. Akinci E, Gurbuz A, Balkanay M, Yakut C, Isik O, Yakut C. The cost effect of coronary artery surgery on beating heart without pump-oxygenator in patients with no additional risk factor. Circulation 1996;94(Supp I):151.
5. Wan S, Izzat MB, Lee TW, et al. Avoiding cardiopulmonary bypass in multivessel CABG reduces cytokine response and myocardial injury. Ann Thorac Surg 1999;68:52-7.
6. Ascione R, Lloyd CT, Underwood MJ, et al. On-pump versus off-pump coronary revascularization. Ann Thorac Surg 1999;68:493-8.