On-pump versus off-pump coronary artery bypass grafting with left internal mammary artery for left anterior descending artery stenosis: a retrospective study over 15 years

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ABSTRACT

Backrounds

The on-pump surgery might induce a higher number of postoperative complications because of the extra-corporal circulation (ECC) that is not a physiological process. Many studies have been done for over ten years to demonstrate the benefits of the off-pump surgery over the on-pump one. To date the results are still controversial.

Objectives

The goal of this study was to compare intraoperative characteristics and 30-day postoperative outcomes of both surgical methods.

Methods

Two hundred forty-three (243) patients operated under off-pump or on-pump CABG (coronary artery bypass grafting) with the left internal thoracic artery (LITA) anastomosed to the left anterior descending (LAD) coronary artery were included retrospectively in this study. We incorporated in our study operations performed from July 1997 to December 2012 in three Swiss hospitals by a single surgical team. Statistical analysis of preoperative, intraoperative and postoperative (30 days) patient characteristics were then proceeded.

Results

Overall patients who underwent off-pump surgery were more often men (81.5% vs 66.1%, p=0.006), were significantly older (median age 67 years old vs 64, p=0.013), had more renal failure (10.9% vs 2.4%, p=0.009) and respiratory failure (20.2% vs 7.3%, p=0.003), had more arteriopathy (16.8% vs 8.1%, p=0.038) and were affected by higher degrees of angina (p<0.001) than those who underwent on-pump surgery. Operating time was shorter in the off-pump group (median 126 min vs 160, p<0.001) but there were more urgent surgery in the on-pump group (10.5% vs 3.4%, p=0.042). There was no significant difference in the postoperative characteristics except intensive care unit stay that was shorter in off-pump group (median 1 day vs 2, p=0.046).

Conclusions

Both surgical techniques are safe and stackable. Thus off-pump coronary artery bypass grafting (OPCAB) is reliable for CABG performed with the LITA on the LAD coronary artery. The choice of surgical method is mainly based on the patient's comorbidities therefore off-pump surgery is often preferred for high-risk patients. It should also be noted that surgeon’s habits directs the choice of the surgical technique.

THEORETICAL BACKROUNDS

Coronary heart disease and myocardial infarction

Atherosclerotic plaques and fatty deposits can bind to the artery walls. Blood clots can then extend the plaques, forming the thrombosis. These elements obstruct the lumen of the vessel leading thereby to angina when the obstruction is incomplete and to heart attack (infarction) when the artery is completely blocked. Afterwards the stenosis of the coronary artery provokes myocardium's ischemia. In worst cases, the infarction can be fatal. If the vessel is quickly revascularized by a medical team, the patient can get out with at best only a few sequels on his cardiac muscle. However these cardiac scars often lead to cardiac failure. Furthermore a first cardiac event is a high-risk factor of other following cardiac events.

Revascularization methods

There are two principal ways to revascularize an obstructed vessel: angioplasty and coronary artery bypass grafting (CABG). Each revascularization technic has its own benefits and disadvantages.

In 2008 a 10-year follow-up of prospective randomized trial comparing bare-metal stenting with internal mammary artery grafting for proximal isolated de novo left anterior coronary artery stenosis[1] showed that both stent implantation and CABG are safe and highly effective in relieving symptoms. The same study showed that long-term prognosis for these patients is excellent with either mode of revascularization. This prospective trial also concluded that the only major difference between the two methods is the higher need for repeated interventions after stenting with bare-metal stents.

Angioplasty

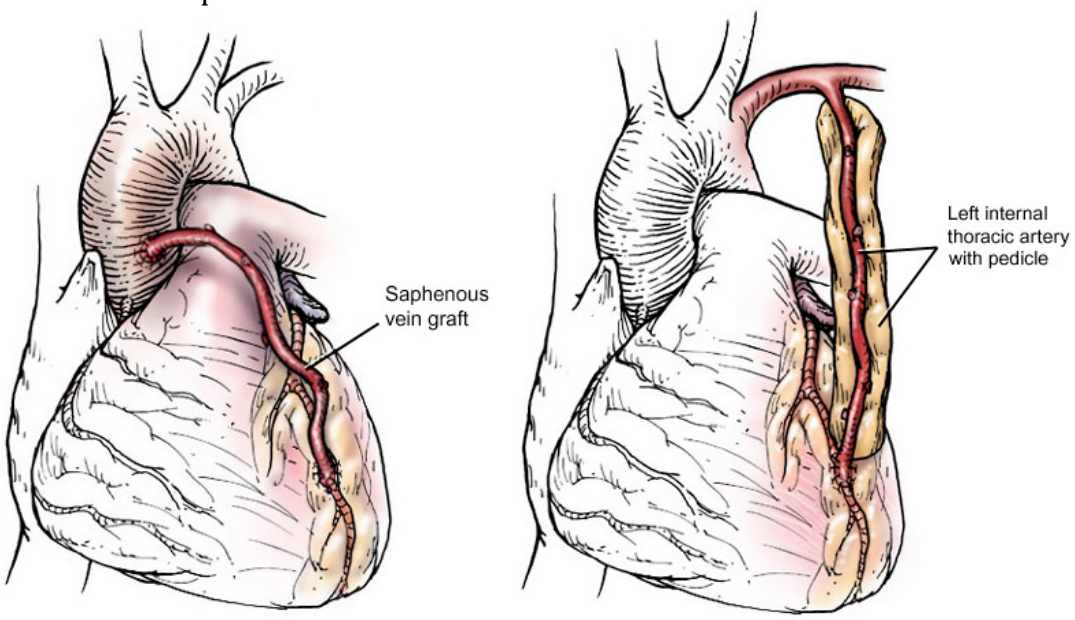
Angioplasty is a less invasive technic because it is made by percutaneous access. It requires the use of a catheter that has a balloon at its extremity. The balloon is routed through the femoral artery to the site of stenosis in the coronary artery. This manoeuvre is performed under X-ray imaging for more precision. Afterwards the balloon is inflated and the atherosclerotic plaque is mechanically removed from the centre of the vessel and plated to the artery wall. Moreover a stent is implemented during the intervention to maintain the expansion of the vessel. However it remains a risk of restenosis due to the fact that clots formation may backslide.

CABG

When the stenosis is too severe to be treated with drugs or angioplasty a surgery should be considered. Coronary artery bypass grafting (CABG) is mostly indicated when the left anterior descending artery is affected or if the three major coronary arteries are concerned by the coronary disease or finally when the left ventricular function is affected.

The principle of this surgery consists to get around the location of the stenosis with a graft. The connexion between the graft and the coronary artery is the anastomosis. The latter is done in two steps. First the coronary artery beyond the blockage is longitudinally incised. Secondly the end of the graft is attached to the incision site on the coronary artery with sutures. The graft may be venous or arterial. Moreover the graft may be pedicled or not. Formerly surgeons used to perform the CABG with the internal saphenous vein taken from the internal side of the leg of the patient. Nowadays the

surgeons prefer to use the internal thoracic artery ITA (also called internal mammary artery IMA) as a graft due to its higher resistance and its better long-term prognosis in term of patency [2]. However in some rare cases surgeon has no choice and is forced to use a venous graft. If an internal saphenous venous graft is used for the bypass, beforehand the surgeon has to take it from the leg of the patient. The graft is then connected to the ascending aorta at one end and to the coronary artery in the post-stenosis region at the other end. This kind of graft is called « non-pedicled ». If an internal thoracic artery is used as a graft, it is easier for the surgeon because the graft is already attached at one end to the subclavian artery. Therefore the surgeons can connect the other end to the coronary artery beyond the stenosis. That's why ITA grafts are known as « pedicled ».



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The patient is under general anesthesia for this kind of surgery. He is ventilated through an orotracheal intubation. The surgery begins with a sternotomy which means that the surgeon incises medially and sagitally the sternum. The surgeon then opens the rib cage and maintains the opening with a spacer. Thus he has free access to the heart and aorta. The surgery may then be performed in two different ways.

1. **On-pump :**

   ONCAB (on-pump coronary artery bypass) :

   Firstly the left internal thoracic artery (LITA) is taken at its extremity that is close to the xyphoid process. But heart is an organ that beats continuously so its movements are a source of surgical inaccuracies. For more accuracy in their job, cardiac surgeons use the extracorporal circulation (ECC). An intracardiac catheter is placed inside the right atrium and another catheter is placed inside aorta. Aorta is then clamped more proximally to insertion of the intra-aortic catheter. Deoxygenated blood is diverted from the right atrium to a heart-lungs machine. This device provides the oxygenating process and the blood flow during the operation. This machine as well controls the blood temperature. Oxygenated blood returns directly inside aorta and is distributed throughout the body. Heart is stopped with a special mixture called cardioplegia. This solution supplies the temporary cardiac arrest due to its cold and rich-potassium content. The patient gets periodically doses of cardioplegia. Once the ECC has started there's no more

need for artificial ventilation. The surgeon can then operate freely and do the anastomosis between the LITA and the coronary artery (for example the left anterior descending coronary artery). When the connexion has been done, cardioplegia is no more administered and patient's heart restarts progressively to beat. Intra-atrial and intra-aortic catheters are withdrawn and the ECC is stopped. Finally the surgeon sets up a drain and sutures patient's thorax.

2. **Off-pump :**
   a) OPCAB (off-pump coronary artery bypass):
      This technique has emerged to improve outcomes for the patient. This surgery is similar to the ONCAB but there is neither heart-lungs machine nor ECC. As the heart continuously beats, operating it is a real challenge for the surgeons because cardiac movements may easily lead to inaccuracies. To limit these movements the surgeons use passive mechanical stabilizers. The use of these devices allows the anastomosis in more confortable and precise conditions. It should also be noted that during OPCAB the coronary artery that will undergo the bypass has to be clamped to prevent bleeding when the incision is done. The clamping has to persist until the sutures are done.
      A new technic is to insert a flexible shunt into the coronary artery in order to perform the anastomosis while the myocardium is perfused.

   b) MIDCAB (minimally invasive direct access coronary artery bypass):
   This surgery is based on the same principles as OPCAB but the surgeon doesn't perform a sternotomy. The surgeon accesses to the mediastinum through a smaller left anterolateral incision in the fifth intercostal space. The aim of this kind of surgery is to limit patient's pain, to reduce patient's scar and to offer a faster recovery time. With this approach only the LAD can be treated with the mammary artery.

METHODS

We first had to submit our study request to the Ethics Commission research on humans of the Canton of Vaud (Switzerland). Given that our study would be retrospective and that it would not involve direct contacts with patients, the Commission accepted quickly our application.

Since 1997 off-pump CABG has been performed regularly by our cardiovascular team, which includes Doctor Ferrari. Our cardiovascular surgeons operate on three different hospitals in Switzerland, namely Lausanne university hospital (CHUV), Valais hospital in Sion (RSV) and Morges hospital. We decided to study all patients that were operated under off-pump or on-pump CABG with the left internal thoracic artery (LITA) anastomosed to the left anterior descending (LAD) coronary artery. The study included patients operated from July 1997 to December 2012 in our three different hospitals.

Thus we had to find all patient records and operational protocols of two hundred forty-three (243) patients. For the most part, patient records and files were digital and available for staff via the online networks but for some of them we had to find the hard copies as well.

It has then allowed us to establish two groups, one group of one hundred nineteen (119) patients operated under off-pump surgery and another one of one hundred and twenty-

four (124) patients operated under on-pump surgery. Preoperative, intraoperative and postoperative (30 days) patient characteristics were then statistically analysed.

STATISTICAL ANALYSIS

The variables are described both generally and according to the intervention method (off or on-pump). Continuous variables are presented as mean±SD if their distribution is approximately normal and as median/interquartile range otherwise. The means were compared using the t-test and differences in medians were evaluated using the Mann-Whitney test. Categorical data are expressed as frequency (percentages) and were compared using the $\chi 2$ test or Fisher's exact test where appropriate. All hypotheses were two-sided and a p-value less than 0.05 was deemed statistically significant. The analyses were performed using Stata version 13.1.

RESULTS

Our two hundred forty-three patients who underwent CABG surgery were divided into two groups, one group of one hundred nineteen patients operated under off-pump surgery and another one of one hundred and twenty-four patients operated under on-pump surgery.

Preoperative characteristics are listed in Table 1.

Table 1. *Preoperative patient characteristics.*

Variable	**Off-pump** *(n=119)*	**On-pump** *(n=124)*	**Overall** *(n=243)*	**P-value**
Age, years (median, IQR)	67 (59-75)	64 (55-70)	66 (57-73)	0.013
Sex Women Men	 22 (18.5%) 97 (81.5%)	 42 (33.9%) 82 (66.1%)	 64 (26.3%) 179 (73.7%)	0.006
Smoking Former Current	55 (46.2%) 35 (29.4%) 20 (16.8%)	49 (39.5%) 23 (18.5%) 26 (21.0%)	104 (42.8%) 58 (23.9%) 46 (18.9%)	0.291 0.047 0.408
Obesity	27 (22.7%)	27 (21.8%)	54 (22.2%)	0.864
BMI (median, IQR)	26.9 (24.6-28.9)	26.1 (24.1-29.4)	26.6 (24.4-29.4)	0.396
Diabetes Type I Type II	28 (23.5%) 10 (8.4%) 18 (15.1%)	29 (23.4%) 13 (10.5%) 16 (12.9%)	57 (23.5%) 23 (9.5%) 34 (14.0%)	0.979 0.580 0.618
Hypertension	81 (68.1%)	83 (66.9%)	164 (67.5%)	0.851
Dyslipidaemia	63 (52.9%)	90 (72.6%)	153 (63.0%)	0.002
Renal failure	13 (10.9%)	3 (2.4%)	16 (6.6%)	0.009
Respiratory failure	24 (20.2%)	9 (7.3%)	33 (13.6%)	0.003
LVEF ≤30% 30-50% ≥50%	 7 (5.9%) 28 (23.5%) 84 (70.6%)	 3 (2.4%) 37 (29.8%) 84 (67.7%)	 10 (4.1%) 65 (26.7 %) 168 (69.1%)	0.253 0.209 0.267 0.631
Previous	8 (6.7%)	6 (4.8%)	14 (5.8%)	0.529

stroke/TIA				
Previous myocardal infarction	47 (39.5%)	41 (33.0%)	88 (36.2%)	0.297
Previous cardiac arrhythmia	8 (6.7%)	13 (10.5%)	21 (8.6%)	0.297
Angina Class I Class II Class III Class IV	119 (100%) 30 (25.2%) 21 (17.7%) 35 (29.4%) 33 (27.7%)	124 (100%) 36 (29.0%) 37 (29.8%) 14 (11.3%) 37 (29.8%)	243 (100%) 66 (27.2%) 58 (23.9%) 49 (20.2%) 70 (28.8%)	0.003 0.503 0.026 0.000 0.717
Arteriopathy Peripheral Carotid	20 (16.8%) 4 (3.4%) 16 (13.4%)	10 (8.1%) 3 (2.4%) 7 (5.7%)	30 (12.3%) 7 (2.9%) 23 (9.5%)	0.038 0.718 0.038
Family history of CABG	22 (18.5%)	27 (21.8%)	49 (20.2%)	0.523

BMI = body mass index; LVEF = left ventricular ejection fraction; TIA = transient ischemic attack; CABG = coronary artery bypass grafting; displayed numbers represent counts (percentage) unless otherwise specified

Patients who underwent off-pump surgery were significantly older (median age 67 years old) than those who underwent on-pump surgery (64, p=0.013). In addition, we found significantly more men in the off-pump group compared to the on-pump group (81.5% vs 66.1%, p=0.006) and more former smokers in the off-pump group (29.4% vs 18.5%, p=0.047). Furthermore, off-pump patients had more renal failure (10.9% vs 2.4%, p=0.009), respiratory failure (20.2% vs 7.3%, p=0.003) and arteriopathy (16.8% vs 8.1%, p=0.038), particularly in the carotid vessels, than on-pump patients. On the other hand, on-pump patients were significantly more affected by dyslipidaemia than off-pump patients (72.6% vs 52.9%, p=0.002). Finally we also noted that on-pump patients had more angina class II (29.8% vs 17.7%, p=0.026) but patients that were operated by off-pump surgery had more angina class III (29.4% vs 11.3%, p<0.001). There was no other significant difference among preoperative characteristics between both groups. In summary, off-pump patients have nevertheless more comorbidities. Indeed they seem to be at higher risk than on-pump surgery but we did not objectify that by calculating the EuroSCORE, which defines the risk in cardiac surgery.

Intraoperative data are listed in Table 2.

Table 2. *Intraoperative data.*

Variable	**Off-pump** *(n=119)*	**On-pump** *(n=124)*	**Overall** *(N=243)*	**P-value**
Operating conditions Urgent operation Elective operation	 4 (3.4%) 115 (96.6%)	 13 (10.5%) 111 (89.5%)	 17 (7.0%) 226 (93.0%)	0.042
Type of operation OPCAB MIDCAB ONCAB	 66 (55.5%) 53 (44.5%)	 124 (100%)		

Cardiopulmonary bypass time, min (median, IQR)		35.5 (29.5-43)		
Aortic cross-clamping time, min (median, IQR)		22.5 (20-29)		
Operating time, min (median, IQR)	126 (110-155)	160 (135-180)	145 (120-175)	<0.001

OPCAB = off-pump coronary artery bypass; MIDCAB = minimally invasive direct coronary artery bypass; ONCAB = on-pump coronary artery bypass; displayed numbers represent counts (percentage) unless otherwise specified

It is important to highlight that no patient initially planned for off-pump CABG was converted to on-pump CABG due to perioperative hemodynamic instability. On the other hand no patient originally planned for on-pump CABG was converted to off-pump CABG because of a perioperative discovery of a non-clampable aorta. Intraoperative analysis revealed two main information. The first one is that operating time is significantly shorter with off-pump compared to on-pump CABG. The median operating time was 126 min (110-155) under off-pump surgery and 160 min (135-180) under on-pump surgery ($p<0.001$). However it is important to note that there were significantly more urgent operations in the on-pump group than in the off-pump one (10.5% vs 3.4 %, $p=0.042$).

Postoperative data are listed in Table 3. Postoperative follow-up includes data up to 30 days.

Table 3. *Postoperative data.*

Variable	**Off-pump** *(n=119)*	**On-pump** *(n=124)*	**Overall** *(n=243)*	**P-value**
Myocardal infarction	3 (2.5%)	1 (0.8%)	4 (1.6 %)	0.362
Cardiac failure	3 (2.5%)	3 (2.4%)	6 (2.5%)	1.000
Renal failure	7 (5.9%)	3 (2.4%)	10 (4.1%)	0.209
Respiratory failure	4 (3.4%)	2 (1.6%)	6 (2.5%)	0.439
Neuropsycological dysfunction	8 (6.7%)	6 (4.8%)	14 (5.8%)	0.529
Stroke/TIA	1 (0.8%)	2 (1.6%)	3 (1.2%)	1.000
Cardiac arrhythmia AF/Flutter Ventricular tachycardia	23 (19.3%) 22 (18.5%) 1 (0.8%)	32 (25.8%) 32 (25.8%) 0	55 (22.6%) 54 (22.2%) 1 (0.4%)	0.217
Conduction block AVB Branch block	3 (2.5%) 2 (1.7%) 1 (0.8%)	3 (2.4%) 1 (0.8%) 2 (1.6%)	6 (2.5%) 3 (1.23 %) 3 (1.23%)	0.853
Gastronintestinal disorder	4 (3.4%)	1 (0.8%)	5 (2.0%)	0.206
Hematologic disorder Anemia Thrombocytopenia	1 (0.8%) 0 1 (0.8%)	5 (4.0%) 4 (3.2%) 1 (0.8%)	6 (2.5%) 4 (1.6%) 2 (0.8%)	0.214
Atelectasis	20 (16.8%)	27 (21.8%)	47 (19.3%)	0.327

Infection Pneumonia Mediastinitis	10 (8.4%) 10 (8.4%) 0	9 (7.3%) 8 (6.5%) 1 (0.8%)	19 (7.8%) 18 (7.4%) 1 (0.4%)	0.629
IABP	1 (0.8%)	0	1 (0.4%)	0.490
Transfusion	2 (1.7%)	2 (1.6%)	4 (1.6%)	1.000
Rethoracotomy for bleeding	4 (3.4%)	3 (2.4%)	7 (2.9%)	0.718
ICU stay, days (median, IQR)	1 (1-2)	2 (1-3)	1 (1-3)	0.046
Hospital stay, days (median, IQR)	10 (8-15)	10 (9-12)	10 (9-13)	0.870
Mortality 30 days	1 (0.8%)	2 (1.6%)	2 (0.8%)	0.498

TIA = transient ischemic attack; AF = atrial fibrillation; AVB = atrioventricular block; IABP = intra-aortic balloon pump; ICU = intensive care unit; displayed numbers represent counts (percentage) unless otherwise specified

The only significant difference postoperatively is the intensive care unit stay. Patients who underwent off-pump CABG had a shorter stay in the intensive care unit compared to those who underwent on-pump CABG. The median of stay in ICU was only one day (IQR: 1-2) for the off-pump group and was two days (IQR: 1-3) for the on-pump group (p=0.046).

There were three myocardial infarctions among the off-pump group (2.5%) and only one in the on-pump one (0.8%); the difference is not significant statistically (p=0.362). In both collective of patients we noticed three cardiac failures after the surgery (2.5% in off-pump and 2.4% in on-pump). Seven (5.9%) among off-pump patients developed renal failure, whereas there were three (2.4%) among on-pump patients (p=0.209). We pointed out four (3.4%) cases of respiratory failure in the off-pump group and two (1.6%) in the on-pump one (p=0.439). We observed eight (6.7%) and six neuropsychological dysfunction postoperatively in off-pump and respectively on-pump groups (p=0.529). Only one cerebrovascular event was noted after off-pump CABG (0.8%), while it was noted twice after on-pump CABG (1.6%); but, once again, the difference wasn't significant (P=1.000). Cardiac arrhythmia, which is a common complication after cardiovascular surgery, occurred among twenty-three (19.3%) off-pump patients (22 AF/flutter and only one ventricular tachycardia) while it occurred among thirty-two (25.8%) on-pump patients (only AF/flutter), but the difference was not statistically significant (p=0.217). There were three conduction blocks in each group after CABG (2.5% in off-pump vs 2.4% in on-pump). Postoperative gastrointestinal disorders were observed among four (3.4%) off-pump patients and among only one (0.8%) on-pump patient (p=0.206). There was only one hematologic disorder after off-pump surgery (0.8%) and there were five cases after on-pump surgery (4.0%) but the divergence wasn't significant statistically (p=0.214). Pulmonary atelectasis, which is another very common complication after open-heart surgery, was observed among twenty (16.8%) off-pump patients and among twenty-seven (21.8%) on-pump patients (p=0.327). We noticed ten cases (8.4%) of infection (exclusively pneumonia) after off-pump CABG and nine (7.3%) postoperative infections (8 pneumonia and 1 mediastinitis) after on-pump CABG (p=0.629). Intra-aortic balloon pump (IABP), which

is the most usable tool of temporary mechanical circulatory support for cardiac surgical patients suffering from low cardiac output in the early postoperative phase, was required just once (0.8%) after off-pump CABG but never after on-pump surgery (p=0.490). Two patients (1.7%) in each group needed postoperative transfusions (p=1.000). There were requirements of rethoracotomy for bleeding among four (3.4%) off-pump patients and three (2.4%) on-pump patients (p=0.718). The average hospital stay was ten days (IQR: 8-15) in the off-pump group and ten days (IQR: 9-12) as well in the on-pump group (p=0.870). Finally there was no significant statistical difference (p=0.498) in thirty-days mortality between both groups. Only one off-pump patient (0.8%) died in the thirty postoperative days while two cases of death were observed after on-pump surgery (1.6%).

DISCUSSION

BRIEF REVIEW OF LITERATURE

On-pump vs off-pump

On-pump surgery induces a higher inflammatory response because extra-corporal circulation is not a physiological process. Many studies have been done for over a decade to demonstrate the benefits of off-pump surgery. To date the results are still controversial. In 2001, Hernandez et al.[3] showed in a study that patients having off-pump coronary artery bypass grafting (OPCAB) are not exposed to a greater risk of short-term adverse outcomes. The OPCAB patients had lower need for intraoperative or postoperative intra-aortic balloon pump, lower rates of postoperative atrial fibrillation, and shorter length of stay. In 2003, Sharif et al.[4] showed in a retrospective comparative study that OPCAB for multi-vessel myocardial revascularization in high-risk patients reduces the incidence of perioperative myocardial infarction and other major complications, intensive care unit length of stay and mortality. Articles published by Kjaergard et al.[5] and Widminsky et al.[6] showed that there were no major differences in conduit flow between on-pump and off-pump. A randomized controlled trial[7] published in 2004 and a retrospective study[8] from 2012 highlighted that OPCAB achieves similar graft patency to ONCAB. Cardiac outcomes and quality of life at 30 days and one year were similar in the randomized controlled trial[7] and OPCAB patients were more cost effective. As referred in an article from 2005 from Hussanein et al.[9] there is no difference of anastomosis quality between those which are performed under OPCAB and ONCAB for the left anterior descending (LAD) coronary artery. However for the other coronary arteries (obtuse marginal, diagonal and right coronary artery) the quality of anastomosis is decreased when using OPCAB because of the precarious accessibility. An article from Vural and coworkers[10] demonstrated that left ITA grafting is a durable treatment for isolated LAD artery disease, in clinical terms and patency terms.
According to a prospective clinical trial from Ramadan et al.[11] off-pump should be used for high-risk patients because it provides complete revascularization with mortality similar to the lower-risk patients undergoing on-pump Y-graft arterial revascularization. A review of literature[12] summarized that OPCAB is as safe as ONCAB. Recent studies from 2013 support the fact that ONCAB doesn't adversely impact survival or freedom from reintervention at 10-year follow-up[13].

All these positive results of OPCAB have though been questioned by other studies in the last decade so controversy persists. It has been argued that intraoperative transit time

flow measurement are lower for OPCAB patients compared to the ONCAB ones[14]. Graft patency at three months has also been measured at a lower rate in an off-pump group compared to an on-pump group[15]. These results suggested that there are adverse impacts on the long-term outcome of ONCAB. In 2009 a randomized prospective study[16] postulated that patients undergoing off-pump coronary artery bypass had worse outcomes and lower graft patency than patients undergoing on-pump coronary artery bypass.

OUR STUDY

As mentioned previously, Sharif et al.[4] and Ramadan et al.[11] showed the benefits of off-pump surgery in the outcomes in high-risks patients. As our study was retrospective, patients operated under off-pump surgery (n=119) or under on-pump surgery (n=124) were not randomized. Off-pump patients had more comorbidities. They seemed to be at higher risk than on-pump patients although we did not objectify that by calculating the EuroSCORE, which defines the risk in cardiac surgery. Even so, we can argue that the choice of surgical method was mainly based on the patient's comorbidities. Nonetheless it should be admitted that every surgeon assesses surgical risks in his own way. Moreover it has also to be noted that surgeon's habits influences the choice of the surgical technique.

Patients who underwent off-pump surgery were more often men (81.5% vs 66.1%, p=0.006), were significantly older (median age 67 years old vs 64, p=0.013), had more renal failure (10.9% vs 2.4%, p=0.009) and respiratory failure (20.2% vs 7.3%, p=0.003), had more arteriopathy (16.8% vs 8.1%, p=0.038) and were affected by higher degrees of angina (p<0.001) than those who underwent on-pump surgery. Operating time was shorter in the off-pump group (median 126 min vs 160 p<0.001) but there were more urgent surgery in the on-pump group (10.5% vs 3.4%, p=0.042). We came to the conclusion as Sharif et al.[4] in the intensive care unit stay. Patients who underwent off-pump CABG had a significant shorter stay concerning intensive care unit compared to those who underwent on-pump CABG (median 1 day in off-pump vs 2 days in on-pump, p=0.046). Despite this, hospital stay was similar in both groups (median 10 days in off-pump and on-pump). In other postoperative characteristics such as myocardial infarction, cardiac failure, neuropsychological dysfunction, stroke, cardiac arrhythmia, transfusion need or rethoracotomy for bleeding, there was no significant difference.

CONCLUSIONS

This study underlines the differences between the patient populations. The off-pump operation being mostly used for high-risk patients has the advantage neither to avoid involving aortic manipulation, nor requiring extra-corporal circulation with cardiopulmonary bypass. Furthermore off-pump surgery has the clinical benefit of reducing the operating time, which narrows as well the risk of perioperative and postoperative complications.

Unfortunately we could not compare long-term prognosis of the patients because our database did only include information up to 30 days postoperatively. In addition, we could not evaluate the completeness of revascularization and graft patency because of the fact that our study was retrospective.

In our study, the rate of postoperative complications and 30-day mortality rate were low and similar in both groups as it was observed by Hernandez et al.[3] and Puskas[7] et al.

Overall both surgical techniques seem to be superposable. Therefore we confirm the review of literature[12] done in 2010 which summarized that off-pump is as safe as on-pump. In conclusion, off-pump coronary artery bypass grafting (OPCAB) is reliable for CABG performed with the LITA on the LAD coronary artery. The choice of surgical method is mainly based on the patient's comorbidities. Then off-pump surgery is often preferred for patients at high risk. It has also to be noted that surgeon’s habits influences the choice of the surgical technique.

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