

Consequences of Coronary Artery Bypass Grafting in Smokers and Addicts

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ABSTRACT

Introduction: The most common cardiac disease is coronary artery disease (CAD) in the world. Coronary artery bypass grafting (CABG) is implemented through two standard surgical techniques, namely off-pump beating-heart CABG (OPCABG) and on-pump CABG (ONCABG). The CABG results in various levels of morbidity, especially in smokers and addicts, who have a lower pain threshold. Regarding this, the aim of this study was to clarify several aspects of the consequences of CABG, especially in smokers and addicts.

Material and Methods: This cross-sectional study was conducted on 125 CABG candidates referring to the Cardiac Department of Ghaem Hospital in Mashhad, Iran, within 2014-2015. The patients underwent either OPCAB or ONCABG. The recorded data included the type and dosage of intra- and post-operative opioids used for the induction and maintenance of anaesthesia, as well as the volume of packed red blood cells, fresh frozen plasma, and platelet. Data analysed using IBM SPSS 19.0 and p-value less than 0.05 considered statistically significant.

Results: According to the results, the mean age of the patients were 59.4±9.8 years. Out of the 125 participants, 89 and 36 patients underwent ONCABG and OPCABG, 71.9% and 58.3% of whom were male, respectively. The sufentanil dose administered for the induction of anaesthesia was 9.9±2.7 cc in the smokers, which was significantly higher in comparison to the dose (7.3±2.1 cc) used for the non-smokers (P=0.015). Furthermore, the mean doses of dobutamine used for the addicted and non-addicted patients were 4.4±1.8 and 5.5±2.2 cc, respectively, which was significantly different between the two groups (P=0.037).

Conclusion: The ONCABG is a common surgical technique, which is used in patients with a more coronary vessel involvement. This study has demonstrated that although the same opioid anaesthetic drugs were used for the smokers and addicted patient, the dose of administered sufentanil was significant different between smokers and non-smokers.

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Introduction

Coronary artery disease (CAD) is the most common cause of mortality in the developing and

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developed countries (1-3). This disease can result in heart failure, decreased left ventricular function, and reduced quality of life (3). Annually, about 561,000 coronary artery angioplasties and 519,000 coronary artery bypass grafting (CABG) are done in the United States (4). The CABG technique was performed in 1968 for the first time (5). This technique was initially advised for single coronary artery involvement. However, it could decline the morbidity and mortality in patients with extensive coronary artery occlusion, especially when the occlusion is due to ischemic heart disease (5-7).

Cardiopulmonary bypass (CPB) has been performed for coronary artery anastomosis for more than 30 years (5). Off-pump beating-heart CABG (OPCAB) is known as a less invasive technique due to avoiding CPB (through supporting the systemic circulation by a machine) and cardiac arrest that facilitates blood flow to distal coronary arteries during heart-pumping (5). According to National Adult Cardiac Surgery Database and Japanese researches 20.4% and 61.4% of all CABG procedure respectively were off-pump technique (4).

Opioids are frequently used as anaesthetic agents. Long-term use of opioids can result in analgesic tolerance through an unclear mechanism (8). Therefore, the addicted patients require higher opioid dose (4, 9). According to several studies, nicotine has analgesic and central nervous system regulatory effects (10). Cardiopulmonary monitoring reduces the mortality and morbidity rates after anaesthesia (10). This monitoring also leads to the reduction of length of stay in intensive care unit (ICU), atrial and ventricle fibrillation risk, number of transfused packed cells, and ventilation time (6, 11-13).

Given the limited evidence on patient prognosis after undergoing OPCAB, surgeons refuse to perform this technique (9). The conversion of off-pump to on-pump technique without any plan increases the risk of mortality and morbidity (14). Cardiac arrest can simplify the performance during surgery (1). That would be able to prevent myocardial ischemia demonstration during surgery (1). The patients undergoing on-pump technique were reported not to have a longer two-year survival, compared to those subjected to the off-pump technique; however, they had a better quality of life in a long run (5). The incidence of some complications, such as reduced glomerular filtration rate, elevated serum creatinine, stroke, and myocardial ischemia, is reported as 5-7% (15). Aortic sclerosis involvement can enhance the risk of perioperative stroke by 14.6% during CABG (9, 16). The incidence of inflammatory response during CPB is a probable event

because this method involves the clamping of the ascending aorta and cannulation that necessitate heparinization without which micro or macro-emboli would occur (17-21). Despite the high prevalence of smoking and addiction in Iran, there are limited data about post-CABG mortality and morbidity. The aim of this study was to clarify several aspects of the consequences of CABG, especially in smokers and addicts.

Materials and Methods

This cross-sectional study was conducted on 125 CABG candidates referring to the Cardiac Department of Ghaem Hospital in Mashhad, Iran, within 2014-2015. The collected data included the patients' demographic characteristics, past medical history, date of admission, drug history (e.g., use of aspirin and Plavix), level of serum creatinine and haemoglobin, and risk factors, such as diabetes mellitus, hypertension, obesity, smoking, addiction, cerebrovascular accident, carotid stenosis.

Ejection fraction (EF) was assessed by echocardiography. To determine the number and type of involved coronary vessels, angiography was performed on all patients by cardiologists. The patients were subjected to one of the two CABG techniques (i.e., ONCABG and OPCABG). Standard sternotomy incision was performed for the exposure of the heart. In the ONCABG technique, 250 unit/kg heparin was administered, and the activated clotting time was kept at 480 sec. The perfusion was continued by a cannula in the right atrium and ascending aorta. We followed the standard management protocol of coronary bypass. Cold blood cardioplegia composed of blood with crystalloid serum was administered in a ratio of 4:1 to save the myocardium.

For the implementation of the OPCAB technique, a heparin dose of 150 unit/kg was utilized, and the activated clotting time was kept at 250 sec. Cardiac stabilization was accomplished by means of the Octopus w3 stabilizer (Medtronic Inc., Minneapolis, MN). Conventionally, coronary shunts are only used for large coronary grafts in OPCAB. We also recorded the type and dosage of intra- and post-operative opiate applied for the induction and maintenance of anaesthesia, as well as the volume of packed red blood cells (PRBCs), fresh frozen plasma, and platelet, if needed.

Statistical analysis

The normality of the quantitative variables was assessed by Lilliefors corrected Kolmogorov-Smirnov test. The comparison of quantitative variables independent t test or

Mann-whitney U test. The categorical variables were analysed through Chi-square and Fisher's exact tests. Data analysis was performed by IBM SPSS, version 19.0 (SPSS Inc., Chicago, IL). P-value less than 0.05 was considered statistically significant.

Results

According to the results, the mean age of the participants was 59.4±9.8 years (age range: 33-64 years). Out of the 125 patients, 89 subjects underwent ONCABG, and the others were subjected to the OPCABG technique. Furthermore, 71.9% and 58.3% of the patients in the ONCABG and OPCABG groups were male, respectively. The two groups were comparable in terms of gender (P=0.141). The patients in the ONCABG OPCAB groups had the mean age of 60.5±10.04 and 56.88±8.83 years, respectively (P=0.063).

The OPCABG group had a higher frequency of diabetic mellitus, smoking, and addiction than the ONCABG group, but none of these risk factors associated with the type of technique were significant (p=0.169, p=0.227, p=0.088 respectively). Those who had already experienced myocardial infarction, had lower Ejection Fraction (30.9±6.6% vs 44.6±9.1%) (p<0.001). Nonetheless, no significant difference was observed between the two CABG techniques in terms of EF (43.1±10.1% in ONCABG vs. 44.9±8.5% in OPCABG) (P=0.331). Table 1 presents the comparison of the two CABG techniques in terms of the risk factors.

In the present study, four types of opioid anaesthetics were administrated. Overall, the mean dosages of fentanyl, sufentanil, and morphine were 37.59±4.6 cc, 36.3±9.7 cc, and 18±4.2 mg, respectively. Sufentanil was more frequently used in the ONCABG than in the OPCAB (Table 2).

Based on the results, 16% and 23% of the patients were smokers and addicts, respectively. The mean sufentanil dose administered for the induction of anaesthesia among smokers was 9.9±2.7 cc that was significantly higher in comparison to the mean dose (7.3±2.1 cc) used for the non-smokers (p=0.015).

Table 1. Comparison of the past medical history and Risk Factors of patients between OPCAB and ONCAB group.

| Variable | OPCAB n= 36 | ONCABG n=89 | P-value |
|-----------|----------------|----------------|---------|
| PMH | | | |
| DM | 16(44.4) | 28(31.5) | 0.169 † |
| HTN | 22(61.1) | 54(67.7) | 0.969 † |
| MI | 2(5.6) | 8(9) | 0.723 ‡ |
| CVA | 2(5.6) | 3(3.4) | 0.625 ‡ |
| Hlp | 13(36.1) | 29(32.6) | 0.705 † |
| RF | | | |
| Obesity | 1(2.8) | 2(2.2) | 0.99 ‡ |
| Smoking | 8(22.2) | 12(13.5) | 0.227 † |
| Addiction | 12(33.3) | 17(19.1) | 0.088 † |

PMH= past medical history; DM= Diabetes; HTN=Hypertension; MI= Myocardial Infarction; CVA= Cerebrovascular accident; Hlp= Hyperlipidaemia; RF= Risk Factor

Data represented as n (%).

† Based on Chi-square test.

‡ Based on Fisher's exact test.

Table 2. Comparison of Operative opium and Inotrop usage between OPCAB and ONCAB group.

| Drugs | OPCAB | ONCABG | P-value ¹ |
|---------------------|-----------|-----------|----------------------|
| Operative opium | | | |
| Fentanile, cc | 37.0±9.0 | 20.00 | 0.043 † |
| Induction, cc | 7.5±1.9 | 9.8±6.1 | 0.202 ‡ |
| Maintenance, cc | 28.8±6.6 | 25.6±6.6 | 0.202 ‡ |
| Sufentanile, cc | 32.6±5.0 | 39.0±3.5 | 0.001 † |
| Induction, cc | 8.7±3.1 | 7.6±2.2 | 0.259 ‡ |
| Maintenance, cc | 28.9±4.4 | 27.9±8.3 | 0.761 ‡ |
| Inotope | | | |
| Dobutamin, µ/kg/min | 4.9±2.4 | 5.3±1.2 | 0.410 † |
| Epinephrin | 0.06±0.01 | 0.06±0.01 | 0.999 ‡ |

Data represented as mean ± SD.

† Based on Mann-Whitney test.

‡ Based on Independent t test.

For the addicted and non-addicted patients, dobutamine was used with the mean doses of 4.4±1.8 and 5.5±2.2 cc, respectively, which was different between the two groups (p=0.037). Table 3 summarizes the research results. Furthermore, the frequencies of PRBC requirement in the addicted and non-addicted patients were 20.7% and 20.8% with the mean doses of 1.3±0.5 and 1.5±0.7 unit, respectively. In addition, 20.0% and 21.0% of the smokers and non-smokers needed PRBC with the mean doses of 1.5±0.6 and 1.4±0.7 unit, respectively. The need to PRBC had no significant relationship with smoking and addiction (Table 4).

Table 3. Relationship between Addiction and Smoking with operative opium.

| Variables | Smoking | | P-value ‡ | Addiction | | P-value ‡ |
|------------------------------|---------------|---------------|-----------|---------------|--------------|-----------|
| | Yes (n=20) | No (n=105) | | Yes (n=29) | No (n=96) | |
| fentanyl, n(%) | 8(40) | 57(54.3) | 0.127 | 16(55.2) | 49(51) | 0.623 |
| Sufentanile, n(%) | 11(55) | 39(37.1) | | 10(34.5) | 40(41.7) | |
| Sufentanile + morphine, n(%) | 0 | 8(7.6) | | 2(6.9) | 6(6.3) | |
| Fentanyl + morphine, n(%) | 1(5) | 1(1) | | 1(3.4%) | 1(1) | |

Data represented as n (%).

‡ Based on Fisher's exact test.

Table 4. Relationship between Addiction and Smoking with packed cell usage.

| Variables | Smoking | | P-value [‡] | Addiction | | P-value [‡] |
|--------------|-------------|-------------|----------------------|-------------|------------|----------------------|
| | Yes n=20 | No n=105 | | Yes n=29 | No n=96 | |
| Necessity to | | | | | | |
| P.C, n(%) | 4(20) | 22(21) | 0.923 | 6(20.7) | 20(20.8) | >0.99 |
| FFP, n (%) | 0 | 3(2.8) | >0.99 | 0 | 3(3.1) | >0.99 |
| Plt, n(%) | 0 | 0 | >0.99 | 0 | 4(4.2) | >0.99 |

P.C= Packed red blood cells; FFP= Fresh frozen plasma; Plt= platelet.

Data represented as n (%).

[‡]Based on Fisher's exact test.

Discussion

This study has shown that it could be useful for comparative purposes regarding the CABG consequences, especially among the smokers and addicts. Previous studies have demonstrated that CABG can improve the prognosis and symptoms of the patients with heart failure (1, 15, 22-26). According to the literature, normal cardiac function is associated with improved EF (1, 27). In this regard, this feature can improve the cardiac function of the patients with heart failure; however, the heart is not able to maintain the suitable cardiac output during the artery grafting (1).

The surgeons, regardless of their experience, assess the risk ratio based on some possible adverse effects, such as myocardial ischemic, immunosuppression, thrombocytopenia, cerebral complication, renal dysfunction, and systemic inflammatory response. Therefore, most of them opt for the off-pump technique (28). In high-risk cases, surgeons consider the less invasive method for CABG (13, 27).

In the present study, we assessed the patients' past medical surgeries and cardiac risk factors and compared their frequency between the two types of surgical techniques. A great number of patients who underwent OPCAB were older and the frequency of diabetic mellitus, smoking, and addiction were much more among them. On the other hand, the patients suffering from more coronary vessel involvement were subjected to the ONCABG technique.

Fentanyl and sufentanil are opioid drugs acting in a short time (29). Sufentanil is 5-10 times stronger than fentanyl and 500 times stronger than morphine. Both of these medications create a suitable hemodynamic condition for the patient. Nonetheless, according to the literature, the administration of sufentanil leads to earlier extubation and less analgesic dose requirement (29).

Nicotine makes up 0.6-3% dry weight of Tobacco and is the basic material of cigarettes (30). Chiang et al. showed that people who are nicotine-dependent has lower pain threshold; therefore, they need more opioid analgesics in the first 24 h post-surgery (30). Opioid drug

doses are determined based on their electroencephalographic effects on patients (29). In the current study, similar opioid drugs were administered for the addicted and smoker patients. However, sufentanil was used with a higher dose in the smokers, compared to that in the non-smokers. The fast-track strategy is targeted toward the earlier extubation of the patients after cardiac operation in the first 1-6 h post-surgery (29). Earlier patient extubation is associated with the enhancement of the left ventricle filling performance (29).

Regarding the adverse effect of opium on spinal anaesthesia, previous studies have reported that opium abusers have lower level of blockage in sensory system compare to the non-abusers (30). This is due to the sensory neural adaptation in these patients (8, 28, 30). Contrary to expectations, the findings of the present study revealed no significant difference between the addicted and non-addicted patients in terms of the administered opioid anaesthetic drugs. However, the smoker or addicted patients received PRBC based on their hemodynamic stability.

Conclusion

The ONCABG is a common surgical technique, which is used in patients with more coronary vessel involvement. The findings of the present study demonstrated that although the same opioid anaesthetic drugs were used for the smokers and addicted patient, sufentanil dose administered for the smokers was significantly different from that used for the addicts. In addition, the addicted patients received a higher dose of dobutamine. Both smokers and addicted patients needed to receive PRBC; however, no significant difference was observed between the two groups in terms of the required PRBC quantity.

One of the limitations of the present study is the few number of smokers and addicts undergoing CABG. Furthermore, it would be better to follow up the patients and record their signs during the hospital stay.

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None.

Conflict of Interest

The authors declare no conflict of interest.

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