

Studying the Effects of the Length of Using Cardiopulmonary Pump on Early Extubation Following the Operation among Patients Candidated for Coronary Artery Bypass Graft

Alireza Kamali ¹, Arefe Beheshtian ^{2*}, Alireza Rostami ³, Afsaneh Nouruzi ¹

¹ Department of Anesthesiology, Arak University of Medical Sciences, Arak, IRAN

² Arak University of Medical Sciences, Arak, IRAN

³ Department of Surgery, Arak University of Medical Sciences, Arak, IRAN

Received 10 August 2017 • Revised 10 December 2017 • Accepted 25 December 2017

ABSTRACT

Prolonged mechanical ventilation is a really important complication among patients candidated for coronary artery bypass grafting. It also accounts for higher death toll, longer periods of hospitalization, and reduced life quality of patients. As a result, early extubation is a common desire among these patients. One of the factors affecting this process is the length of utilizing pump. The present research seeks to study the effect of the length of utilizing pump on the length of extubation among patients undergoing coronary artery bypass grafting. This is a cross sectional – analytical research conducted on 360 patients candidated for CABG selected based upon the inclusion criteria. The length of pump utilization and Aorta cross clamp, and the length of extubation since entering ICU (after they were moved to ICU) were recorded in research questionnaires and the resulting information was finally analyzed. As it turned out, a longer period of hospitalization would result in a significantly longer time of extubation for patients. The average extubation time for those patients who were under pumping for more than 120 minutes was longer than 2 hours ($P = 0.01$). A longer period of pumping was significantly associated with higher mortality rates and a linear correlation is observed between these two variables. The mean length of pumping among those patients who had passed away was 169.8 ± 7.8 minutes ($P = 0.0001$). A study of these patients illustrated the fact that as the length of using pump grows longer, the possibility of atrial fibrillation also goes up ($P = 0.01$). Longer use of pump results in longer extubation time and causes late extubation.

Keywords: early extubation, coronary artery bypass grafting (CABG), length of using pump

INTRODUCTION

CABG is a therapeutic strategy used to treat those suffering from cardiac ischemic diseases. Considering the large range and great extent of CABG operation, there is increasing tendency to minimize patients' stay in the ICU and the utilized facility [1]. Prolonged mechanical ventilation (PMV) is a major and well-known complication among these patients. Although this complication is observed only among 3 to 9.9% of all patients, it may be significantly associated with the death toll and paralysis of patients. Patients with PMV may experience complications such as longer stay in ICU, longer time of hospitalization, higher treatment costs, and reduced life quality [2, 3, and 4]. Considering the recent advances made in operation techniques and anesthesia, the popularity of early extubation is on the rise. Early extubation is a terms used to describe the process of extubation within the first 6 to 8 hours after operation. Although the majority of patients who have experienced early extubation have less cardiac and background diseases, this process is not far from possible among patients suffering from several

© **Authors.** Terms and conditions of Creative Commons Attribution 4.0 International (CC BY 4.0) apply.

✉ alikaliiir@yahoo.com ✉ Arefeh.beheshtian@yahoo.com (*Correspondence) ✉ alirezarus@yahoo.com

✉ norouzi43@yahoo.com

chronic background diseases [3, 4, 5]. Early extubation has a major influence on improving eyelash functioning, mucosal transport, reduced incidence of pneumonia, lung atelectasis and other pulmonary complications. This process also improves cardiac diastolic performance and reduces therapeutic costs and the length of hospitalization in ICU and results in shorter stay at hospital. Some studies have shown that as many as 55 to 80% of patients are capable of extubation within the first 8 hours following their operation. It should be made clear that the initial goal setting for early extubation is shorter than 8 hours [2, 6, 7]. Based on various studies, patients' respiratory adequacy (measured based upon the gas analysis in arterial blood) and their full consciousness are extubation criteria. What's more, hemodynamic parameter of patients should also be in the normal range [4, 8, 9]. The factors that affect early extubation can be classified into three groups: the risk factors prior, during, and after the operation [4, 5]. The following variables are defined as during the operation risk factors in the present research: 1. Length of CPB, 2. IABP usage, and 3. Aortic cross clamp timer. Considering the importance of early extubation process in this group of patients, the present research seeks to study the effects of pumping time on early extubation and other side effects of CABG such as incidence of arrhythmia and the death toll among patients.

MATERIALS AND METHODS

This is a cross sectional – analytical research conducted over a period of 20 months in order to analyze the effect of length of using pump during CABG operation on early extubation. In this research, all patients candidated for CABG resorting to Amir-al-Momenin Hospital of Arak who were qualified for inclusion in the research were studied as the research population. Next, the pump time and length of Aorta cross clamp were recorded for all patients. After the operation was over and when patients were sent to ICU, patients' length of extubation since entering ICU was recorded in questionnaires. Other demographic information such as age, gender, length of the process of operation, background diseases, history of other operations, length of stay in ICU, length of hospitalization, incidence of respiratory problems after operation and the mortality rate were also recorded in specially designed questionnaires and forms. The resulting information was finally analyzed using SPSS v.19 and t-test and presented in tables and charts. All patients admitted by the cardiac surgeon entered the operation room and received the necessary premedication. Then, they underwent the required monitoring including Spo₂, ECG, PR, RR, NIBP, T, and ETco₂. They were all given anesthetics induction. Next, arterline and CV line were inserted for all of them and their IBP cvp was recorded. Having opened the chest wall and prepared the patients for cardiopulmonary pump, the patients underwent cardiopulmonary pumping and they were prepared for grafting. The exact length of pump time and cross clamp for each patient were recorded in special questionnaires. With the pumps switched off and the end of the operation process, the intubated patients were moved to ICU-OH and the length of their intubation since entering ICU until extubation was recorded. The information obtained through questionnaires concerning length of pump time, cross clamp aorta, and its effect on the length of extubation were statistically analyzed using T-test and regression.

Inclusion criteria: 1. All class I and II ASA patients candidated for CABG resorting to Amir-al-Momenin Hospital of Arak, 2. Non-emergency patients candidated for CABG, 3. Patients candidated only for CABG who need no further operations such as valve replacement, and 4. Aging 35 to 80 years old.

Exclusion criteria: 1. Patients who disagreed to take part in the research, 2. All patients with treated COPD, and 3. Patients who were sent back to the operation room while they were staying in the ICU or CCU.

This research holds the ethical code IR.ARAKMU.REC.1394.295 issued by Arak University of Medical Sciences.

RESULTS

As many as 64.7% of the participants in this research were male and the average age of individuals was 62.82 ± 8.8 years old.

As the length of pump time goes up, the average length of extubation also increases. For those patients whose pump time was longer than 120 minutes, an average extubation time of longer than 7 hours in ICU was reported ($P = 0.01$). Consequently, the length of pump time exhibits a linear link with the average length of patients' extubation [Figure 1].

No significant difference was observed between the length of staying in the ICU and the average length of patients' hospitalization in the two groups with pump times less and more than 120 minutes (according to $P \geq 0.05$). In other words, no correlation was observed between the length of patients' pump in the operation room with their average stay in ICU and their length of hospitalization [Table 1]

As the length of pumping increases, the mortality rate also rises significantly and a linear correlation is observed between these two variables. The average length of pumping among those patients who passed away was 169.8 ± 7.8 minutes ($P = 0.0001$) [Table 2].

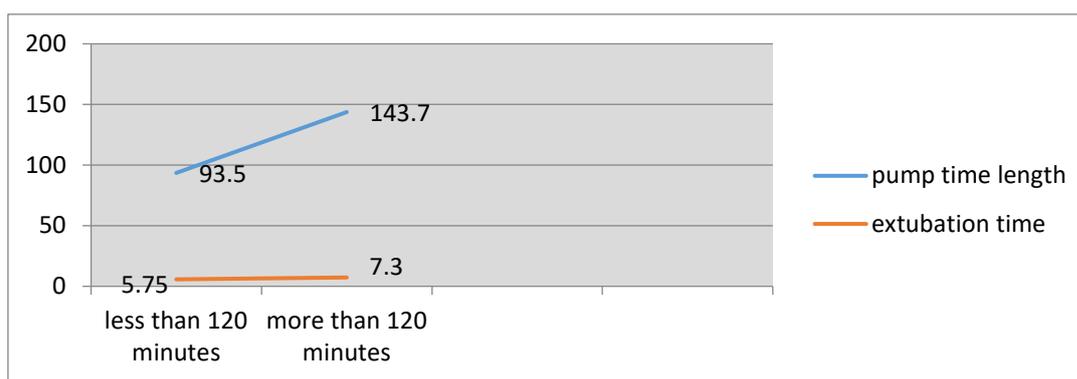


Figure 1. Pump time length and its correlation with patients' extubation time

Table 1. Comparing pump time length and the mean time of staying in ICU and average hospitalization time among patients candidated for coronary artery bypass grafting

Groups	Pump time longer than 120 minutes	Pump time shorter than 120 minutes	P-value
Mean pumping length	143.7 ± 11.8	93.55 ± 9.9	P = 0.01 significant
Length of staying in ICU	4.4 ± 1.8	4.2 ± 2.1	P ≥ 0.05 not significant
Length of hospitalization	10.9 ± 3.7	10.2 ± 4.8	P ≥ 0.05 not significant

** T-test

Table 2. Comparing the pumping time and the average mortality rate among patients candidated for coronary artery bypass grafting

Groups	Pumping time longer than 120 minutes	Pumping time shorter than 120 minutes	P-value
Average mortality percentage	11.1%	0	P = 0.0001 significant

Further analysis also revealed that as the pumping time grows longer, the possibility of atrial fibrillation also goes up ($P = 0.01$) and a linear correlation is observed between the length of pumping time and atrial fibrillation incidence. As the length of pump time increases, the possibility of atrial fibrillation also goes up.

DISCUSSION AND CONCLUSION

Obtaining a significant correlation between pumping time among patients candidated for CABG and their extubation time in open heart ICU is one of the goals of anesthesiologists to better manage patients under CABG. Our research studied the patients applying for CABG resorting to Amir-al-Momenin Hospital of Arak for 20 months. We focused our attention on the correlation between pumping length of patients and their extubation length in open heart ICU. The results indicate a direct and linear correlation between average pumping time of patients and the mean time of extubation in open heart ICU. In other words, as the average length of pumping time goes up, the average extubation time in ICU also increases (patients with pumping times longer than 120 minutes exhibited an extubation time above 307 minutes). A review of the previous researches also indicated similar results. A study by Ji et al on 416 patients undergoing CABG in Shanghai found that elongated cardio-pulmonary bypass is one of the factors that influences late extubation. Longer period of cardio-pulmonary pass is linearly correlated with late extubation. Using pump balloon and reduction of hemoglobin to 20% of the basic level are other factors that influence late extubation [1]. The results of this research are clearly in line with those achieved in our research as the length of pumping time is linearly correlated with extubation time.

In a similar study by Dr. Shahbazi et al conducted on 314 patients candidated for CABG in the city of Shiraz, no correlation was found between the pumping time of patients candidated for CABG and the average extubation length of patients in ICU-OH ($P > 0.05$). Raising the pumping time to even longer than 120 minutes had no influence on extubation time. Other variables such as gender failed to show any influence on extubation length [2]. These results are not in line with those achieved in our research. In our research, raising the pumping time to more than 120 minutes increased the extubation length to more than 307 minutes. In another research by Gumus et al (2010 to 2014) on 830 patients candidated for CABG in Istanbul, Turkey, it turned out that various factors influence the length of patients' extubation in ICU-OH. Elongated time of cardio-pulmonary bypass is of significant importance here and contributes to longer extubation time. After 82.5 minutes, every single minute rise in pumping time increased the late extubation time for 3.5 percent [3]. The results of this research are also in line with those we have

achieved. We arrived at the conclusion that raising the pumping time to more than 120 minutes resulted in longer extubation time, even more than 307 minutes. Another research by Natarajan et al (2002) conducted on 407 patients candidated for CABG showed that various factors influence elongation of extubation time. Longer cardio-pulmonary bypass time was a really effective factor which had a greater influence compared to other factors such as age, gender, EF, DM, and the renal functioning of patients (GFR level) [4]. This research is also in line with our study and the present study has also pointed to the linear correlation between patients average pumping time and the average extubation time. Just like our research, increasing the pumping time to more than 120 minutes elongates the extubation period to longer than 240 minutes. A similar research was also conducted by Totonchi et al on 743 patients resorting to Shahid Rajaiee Hospital of Tehran, Iran. It turned out that Prolonged Mechanical Ventilation was observed in 6.1% of all patients and various factors before, during, and after operation such as gender, COPD, chronic renal diseases, endocarditis, operation type, length of pumping, and bleeding influence this issue [5].

The results of this research are also in line with those we have achieved in our study. According to the results of our research, the length of pumping influences early extubation. In another research by Dr. Kamali et al (2017) on 120 patients resorting to Amir-al-Momenin Hospital of Arak, Iran, the effects of BIS monitoring on the early extubation of non-emergency patients candidated for CABG were studied. It turned out that presence of BIS reduced extubation time among ICU-OH patients. As it was pointed out in this research, various factors can influence the average length of extubation. Standard and proper depth of anesthesia is the most important factor. Factors such as gender and age had no influence on the average length of extubation [6]. Our research also failed to find a correlation between gender and age with the average extubation length. A review of the previous researches indicates the significant influence of pumping time on the Late Extubation of patients candidated for CABG in ICU-OH. As for those patients candidated for CABG who had undergone ON-PUMP operation, longer period of cardio-pulmonary bypass or the longer time they spent on cardio-pulmonary pump had several unfavorable effects on patients' status. The most important side effect is longer period of patients' extubation in ICU-OH which may cause many other side effects among these patients. Although the Prolonged Mechanical Ventilation of these patients occurs in merely 3 to 9.9% of all cases, it accounts for a considerable degree of death toll in these patients [2]. Early extubation is a terms used to describe the process of extubation within the first 6 to 8 hours after operation. It may shorten patients' stay in the ICU, length of hospitalization and the pulmonary complications caused by elongation of extubation time. As a result, we will observe a lower death toll among patients and the treatment costs will decrease significantly [1, 3]. A review of the previous studies showed that one of the most important risk factors of patients' late extubation during operation is the longer pumping time and the same results were also reported in our study as well. As a result, taking measures to shorten the pumping period by the operation team has a great effect on patients' early extubation and may reduce the secondary complications.

Elongating the pumping time will clearly elongate the extubation time and cause late extubation.

REFERENCES

1. Ji Q. Risk factor for late extubation after coronary artery bypass grafting. *Heart Lung*. 2010;39(4):275-82. <https://doi.org/10.1016/j.hrtlng.2009.09.002>
2. Shahbazi Sh. Predictive Factors for Delayed Extubation in the Intensive Care Unit after Coronary Artery Bypass Grafting; A Southern Iranian Experience. *Iran J Med Sci*. 2012;37(4):238-41.
3. Gumus F. Prolonged Mechanical Ventilation After CABG: Risk Factor Analysis. *Journal of Cardiothoracic and Vascular Anesthesia*. 2015;29(1):52-8. <https://doi.org/10.1053/j.jvca.2014.09.002>
4. Natarajan K. Predictors of Prolonged Mechanical Ventilation After On-pump Coronary Artery Bypass Grafting. *Annals of Cardiac Anesthesia*. 2006;9(1):31-6.
5. Totonchi Z. Predictors of Prolonged Mechanical Ventilation after Open Heart Surgery. *J Cardiovascular Thoracic Res*. 2014;6(4):211-6. <https://doi.org/10.15171/jcvtr.2014.014>
6. Kamali A. Studying the Effects of BIS Monitoring (Depth of Anesthesia) in Early Extubation of Patients Candidated for Non-Emergency CABG. *Biomed Pharmacol J*. 2017;10(1):199-206. <https://doi.org/10.13005/bpj/1098>
7. Al-Sarraf N. Cross-clamp time is an independent predictor of mortality in low-and high-risk cardiac patients. *International Journal of Surgery*. 2011;9(1):104-9. <https://doi.org/10.1016/j.ijssu.2010.10.007>
8. Moshiri E, Dadash P, Golestani Eraghi MN, Taheri MN, Mohamad AB. Prophylactic Effect of amiodaron in Af after CABG. *Journal of Cardio vascular disease research*; 2015;6(1):12-7.
9. Kasper D, Longo D, Jameson L, Fauci A. *Harrison's principles of internal medicine*. 19th ed. New York: McGraw Hill Education Medical. 2015.