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Original Article

Predictive Factors for Delayed Extubation in the Intensive Care Unit after Coronary Artery Bypass Grafting; A Southern Iranian Experience

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Abstract

Background: Early extubation is implemented in cardiothoracic units worldwide for its advantages such as decreased mortality, morbidity, and hospitalization costs. We conducted a retrospective study to evaluate potential factors which may affect extubation time.

Methods: The records of 334 eligible patients who underwent elective coronary artery bypass grafting (CABG) in 2008 in Kowsar Hospital in Shiraz, southern Iran were evaluated to find the factors that can affect the extubation time. The patients were divided to early (equal or less than 6 hours) and late extubation groups. The patients' demographic data and operative variables were extracted from the records. We excluded patients with difficult intubation, severe acid base disturbance, neurological problems, and cardiovascular instability; and those who used intra-aortic balloon pump, had underwent emergency operation, or had another concomitant surgery.

Results: Multiple logistic regressions comparing age, sex, number of grafts, ejection fraction, pump time, hematocrit, number of risk factors, and number of inotropic drugs, identified only age as a predictor of delayed extubation (odds ratio=1.07, CI 95%=1.04-1.10, P<0.001). Also, in both studied groups the men to women ratio was higher (P<0.05).

Conclusion: Although in our study age was the only predictive factor for delayed extubation, a comprehensive study including preoperative, perioperative, and postoperative factors is recommended in our area.

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Introduction

Prolonged mechanical ventilation after coronary artery bypass grafting (CABG) increases the rate of mortality and morbidity as well as hospitalization costs.[1,2] Currently, with the development in surgical and anesthesia techniques, there is an emerging interest in early extubation in order to reduce health costs and negative outcomes associated with delayed extubation.[3] Early extubation, defined as extubation within 6-8 hours after the end of operation, reduces the length of intensive care units (ICUs) stay and reflects the trend for fast

paced cardiac anesthesia. Prolonged mechanical ventilation after cardiac surgery is related to post operative complications and patients' morbidity.[4] Moreover, prolonged mechanical ventilation leads to more ICU stay imposing higher costs on the patients.[5] If patients breathe without assistance, they need less intervention and the costs of both equipment use and nursing care decrease dramatically.[6]

Early extubation is implemented in cardiothoracic units worldwide for its advantages. As previously shown, patients undergoing CABG surgery can experience early extubation without main complications.[3] This concept in not only considered for patients with less cardiac problems, but also for patients with more severe illness.[7] Parkash and co-workers found that early extubation could be performed within 3 hours. They also showed that patients who had undergone early extubation had shorter ICU stay and none of them had pulmonary complications.[8] Yende and colleagues found that the most common cause for delayed extubation was low level of consciousness and hypoxemia. An 8-hour cutoff was set for early extubation in their study.[9]

Very few studies have been conducted in Iran on the factors affecting the time of extubation in patients undergoing cardiac surgery.[10] Therefore, we aimed to evaluate the potential factors which may affect extubation time in Shiraz, southern Iran.

Materials and Methods

In a retrospective study, we conducted a review of the records of 334 eligible patients who underwent elective coronary artery bypass grafting (CABG) in 2008 in Kowsar Hospital, affiliated to Shiraz University of Medical Sciences, Shiraz, southern Iran. The study was approved by the University's Ethics Committee.

The patients' demographic data and operative variables were extracted from the records. All patients scheduled for CABG surgery were enrolled in the study. We excluded patients with difficult intubation, severe acid base disturbance, neurological problems, and cardiovascular instability, and those who used intra-aortic balloon pump, had underwent emergency operation, or had another concomitant surgery.

The anesthesia technique had been the same for all the patients. Balanced anesthesia was induced with 0.1-0.2 mg/kg intravenous midazolam, 0.1-0.25 µ/kg sufentanil, 0.1-0.15 mg/kg morphine, 1-2 mg/kg sodium thiopental, plus 0.08-0.12 mg/kg intravenous pancuronium for muscle relaxation. Anesthesia was maintained with isoflurane.

Standard CABG had been performed by the same groups of surgeons and anesthesiologists throughout. The patients had been transferred to the ICU and extubated after hemodynamic and respiratory stability.

To determine factors associated with the extubation period, the patients were selected regarding extubation time. One group had an extubation time of equal or less than 6 hours (early extubation group) and another group had experienced longer extubation time (delayed extubation group). The extubation criteria were adequate ventilation according to arterial blood gas analysis and full consciousness of the patients. Also hemodynamic parameters of the patients should be within normal limit.

Data were presented as mean (±SD) or ratios as appropriated and analyzed using SPSS software, version 13 (Chicago, IL, USA). P value of <0.05 was considered as statistically significant. In univariate analysis, the differences were analyzed using *t* test for continuous variables and chi-square test for discrete variables. Consequently, in multivariable analysis, multiple logistic analyses of variance were conducted to reveal predicting factors of delayed extubation. The dependent variable was group indicator (early or delayed group), with the factors as independent variables.

Results

We selected 167 patients with early extubation and 167 patients with delayed extubation time. We found a significant difference in age (P<0.001) and sex (P=0.032) between the patients with early and delayed extubation (univariate analysis, table 1). There were not significant differences in baseline data including ejection fraction (P=0.21) and risk factors (P=0.27) between the two groups (table 1).

Also, we found no significant difference in the number of grafts, pump time, lowest hematocrit during pump and use of inotropic drugs between the groups (P>0.05, table 2).

The mean (±SD) extubation times were 5.36 (±0.83) and 11.24 (±4.32) in the early and delayed extuabtion groups, respectively (P<0.001). Only age was the best predicting factor for delayed extubation (odds ratio=1.07, CI 95%=1.04-1.10, P<0.001, multiple logistic regression).

Discussion

In our study, patients in the delayed extubation group were significantly older than the patients in the early extubation group (62.5 [± 9.4] vs. 55.5 [±9.6] years). Multiple logistic regressions comparing age, sex, number of grafts, ejection fraction, pump time, hematocrit, number of risk factors, and number of inotropic drugs, identified only age as a predictor of delayed extubation.

Table 1: Baseline characteristics of the studied groups with early and late extubation

Variables	Groups			P value
	Early extubation		Delayed extubation	
Age (mean [±SD] years)	55.54 (±9.6)		62.56 (±9.4)	<0.001
Sex (Male/Female)	41/126		59/108	0.032
Ejection fraction (mean [±SD] percentage)	52.45 (±9.36)		51.14 (±10.05)	0.21
Number of risk factors				
0	24	20	44	0.27
1	49	60	109	
2	72	57	129	
3	19	28	47	
4-5	3	2	5	

*Risk factors: 1-diabetes mellitus, 2-hypertension, 3-hyperlipidemia, 4-CVA, 5-renal failure

Table 2: Mean (±SD) and frequencies of some factors in the early and delayed extubation groups based on the univariate analysis results

Factors	Groups		P value
	Early extubation	Delayed extubation	
Number of grafts	3.50 (±0.89)	3.51 (±0.87)	0.92
Pump time (min)	75.63 (±21.50)	79.28 (±37.36)	0.27
Hematocrit during pump	25.72 (±3.31)	25.21 (±3.35)	0.16
No inotrope use	104	86	0.07
Dopamine use	57	86	
Epinephrine use	6	13	
Extubation time (hours)	5.36 (±0.83)	11.24 (±4.32)	<0.001

Consistent with our findings, some studies identified age as a significant predictor of delayed extuabation with the older patients having longer intubation time.[11] Suematsu and co-workers assessed many preoperative, perioperative, and postoperative factors affecting extubation times. They found that factors such as age more than 70 years and presence of heart failure as the predictors for extubation time while the number of graft had no association.[2] Similarly, Cislaghi and colleagues revealed that age more than 65 years, pump time more than 77 minutes, and ejection fraction less than 30% were associated with prolonged mechanical ventilation in patients undergoing cardiac surgeries.[12]

Some other studies showed older age,[13] female sex,[4-13] use of inotropic drugs,[6] and ejection fraction ≤30%,[13,14] to be risk factors for delayed extubation, which were not significant risk factors in our study except for older age. All of our patients had an ejection fraction of more than 50%. Therefore, it is reasonable that no such association was found in our study.

In a study conducted in Iran pump time did not have a significant effect on the extubation time after CABG surgery, which is in line with our finding.[10] One probable explanation is that the mean pump time was short in their study (63.7 min) as well as our study (77.4±0.3 min). Some previous published data showed that mean pump time longer than 91 min,[12] was associated with prolonged tracheal intubation because of strong vasoconstriction and pulmonary edema caused by higher endothelium-1 levels after extended pumping time.[6] These data also show that transfusion of more than 4 bags of blood or fresh frozen plasma is an independent predictor of prolonged mechanical ventilation.[12]

Cislaghi and co-workers showed that a left ventricular ejection fraction of <30%, cardiopulmonary bypass time longer than 91 min, redo surgery, and transfusion of more than 4 bags of red blood cells or fresh frozen plasma were independent predictors of prolonged mechanical ventilation.[12] Moreover, an age of more than 80 years had a significant role in the duration of mechanical ventilation in patients who had cardiac valves and/or combined surgeries. Other variables such as cerebral vascular accident, renal failure, bleeding, and infection were also associated with prolonged mechanical ventilation.[11] Other studies show that age >65 years, severe left ventricular dysfunction, and emergency surgery are associated with prolonged mechanical ventilation.[14]

One of the limitations of our study was that it was performed on patients with good left ventricular function. Further studies can be performed on patients with both poor and good left ventricular function to find the effect of cardiac performance on extubation time. Also, we did not include other variables which may affect extubation time such

as anesthesia time, aortic cross-clamping time, or transfusion and glucose levels. The other limitation of our study was that we considered adequate ventilation, full consciousness of the patients, and normothermia as extubation criteria. It is recommended that other criteria such as respiratory rate of <30 per minute ,vital capacity >15 cc/kg, and other classic criteria for extubation be considered for further studies.

Conclusion

Our multivariate analysis revealed that only increased age could predict delayed extubation. A comprehensive study including preoperative, perioperative, and postoperative factors is recommended in our area.

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Conflict of interest: None declared

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