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Intraoperative variables associated with extubation time in patients undergoing open heart surgery

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Abstract

Decreasing mechanical ventilation and early extubation in patients has many clinical benefits. Hence, an awareness of some variables, associated with extubation time can help nurses to plan convenient care aimed at making a safe and early extubation. The purpose of this study was to investigate whether any intraoperative variables had a significant effect on extubation time following open heart surgery. The research was conducted on 60 open heart surgery patients who met inclusion criteria between April 2014 and November 2014 in a cardiac and vasculer surgery clinic of university hospital in Istanbul, Turkey. The data were collected by using a “Questionnaire Form” which includes some intraoperative variables (type of surgery, the number of grafts, the duration of time of the cardiopulmonary bypass, aortic cross-clamping, total operation time, and the extubation time). The data was analyzed by descriptive and analytical methods. Type of the surgery procedure was 40 (66%) patients were CABG, 10 (16,6%) were valvuler surgery, 6 (10%) were ASD/VSD primer repair and 4 (3,3%) were Bentall procedure. Extubation was achieved for 60 patients in a mean time of 8.33±1.99 h. 18,3% (11) of the patients were extubated in ≤6 h and 81,7% (49) of them were extubated in >6 h after surgery, classifying them into the early and delayed extubation groups, respectively. On statistical analysis, the duration of the cardiopulmonary bypass (CPB) and aortic cross-clamping were found to have a significant effect on the extubation time.This study revealed that the duration of the cardiopulmonary bypass and aortic cross-clamping might play a role in the extubation time. Therefore, it is recommended that nurses consider this in their assessment of extubation as a shorter cardiopulmonary bypass time and aortic cross-clamping time might lead to earlier extubation.

Keywords: Open heart surgery; extubation; intraoperative variables.

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1. Introduction

The aim of treatment and care after cardiac surgery is to allow the patient to get out of the anesthesia, to wake up, to be extubated and to ensure that spontaneous respiration can pass normally. Other aims are to ensure adequate oxygenation with adequate alveolar ventilation, to maintain alveolar clarity, to increase functional residual capacity, to reduce systemic oxygen consumption and to provide stabilization by supporting the chest wall from the inside (Sahinoglu & Cinel, 2011; Roekaerts & Heijmans, 2012).

After open heart surgery, the patient's respirator functions (vital capacity, total lung capacity, inspiratory capacity and functional residual capacity) are decreased using anesthesia and cardiopulmonary bypass (CPB); so after surgery patients are taken to intensive care unit with support of mechanical ventilation (Bojar, 2011; Roekaerts & Heijmans, 2012). Today, debates about the optimal time of extubaion after heart surgery are still ongoing (Roekaerts & Heijmans, 2012). Despite the fact that studies show that extubation in the operating room is well done, rapid changes in hemodynamic instability, changes in body temperature, mediastinal blood and fluid loss and other hemostatic disorders are expected in the first few hours postoperatively (Lee & Jacobsohn, 2000; Djaiani et al., 2001; Roekaerts & Heijmans, 2012, Rodriguez-Blanco et al., 2012, Garg et al., 2014; Hamilton et al., 2014).

Early extubation in the literature has been shown to be possible after 6 hours of cardiac surgery. Some studies have shown that the appropriate time for extubation in some cases is two to six hours after surgery; While in some it is shown to be safe between four and eight hours, the current trend is to apply within the first 12 hours after surgery (Uncu et al., 2004; Martin & Turkelson, 2006; Imanipour et al., 2008; Bowles, 2010; Roekaerts & Heijmans, 2012).

Many studies have demonstrated the benefits of early extubation. These are the less staying time in intensive care unit, decreased morbidity and earlier mobilization. In addition, it has been shown that the ciliary function returns with early tracheal extubation, and respiratory functions improve. Early extubation decreases the incidence of nasocomial pneumonia (Doering, 1997; Goodwin et al., 1999). Early mobilization is allowed with early extubation and thereby complications related to immobilization such as deep vein thrombosis, pulmonary embolism and pneumonia are reduced. Early exubation is not only improves patient care standards and physical recovery, but it also reduces costs. Cheng et al. (1996) reported that early extubation after CABG surgery is cost beneficial and improves resource use when compared to late tracheal extubation.

When the appropriate timing and method are not selected, the separation process is extended; pulmonary complications (pneumonia, sepsis, pulmonary embolism, barotrauma, atelectasis) and it can lead to some undesirable effects such as hemodynamic disorders. This situation prolongs the staying intensive care unit of the patient, increases the cost of treatment, and morbidity and mortality are seen as the most important reasons (Sacar et al., 2008; Camp et al., 2009; Hawkes et al., 2010; Pandit, 2010; Koyuncu et al., 2011; Garg et al., 2014).

Determination of the factors that may affect the patients' staying time after open heart surgery provides preliminary measures in the preoperative period. Studies have shown that factors that prolong post-operative extubation time are age, gender, operation time, minumum body temperature, cross clamp time, total perfusion time, number of bypass vessels, use of inotropic agent, amount of colloid fluid in intensive care unit, blood transfusion, hourly average urinary output to extubation, chest drainage volume, intraaortic balloon pump (IABP) usage, dose and duration of anesthesia, and partial oxygen pressure (PaO_2) (Sacar et al., 2008; Imanipour et al., 2008).

Critical care nurses spend long time with patients and observe them closely. Critical care nurses in the separation process from mechanical ventilator have a special and important role because they are one of the best-known healthcare team members (Koyuncu et al., 2011). Critical care nurses who are interested in the some critical intraoperative variables that can affect the extubation time, will be able to make an informed decision about extubation time. Determining which open heart surgery patients are suitable for early extubation will help nurses plan appropriate care aimed at safely reducing the lenght of syat in intensive care unit and the cost associated with intubation and mechanical ventilation (Doering et al., 1998; Branca, 2001; Walthall & Ray, 2002; Imanipour et al., 2008).

2. Method

The study took place at a university-affiliated hospital, located in Istanbul, Turkey, and the investigation applied the principles outlined in the Declaration of Helsinki. A crosssectional design was used. All of the patients who underwent elective open heart surgery by one surgeon between April 2014 and November 2014 were included within the study. The inclusion criteria were all of the patients that had undergone elective open heart surgery via median sternotomy with standard cardiopulmonary bypass (CPB) techniques, without a history of cardiac surgery. The patients of one surgeon and one cardiac surgery center were selected to reduce the number of variables that could have biased the study. The sample involved 75 patients. From these and according to the inclusion criteria, only 60 eligible patients were selected by a convenience sampling method. The data were obtained with the "Structured Patient Information Form" which included some intraoperative data (type of surgery, number of grafts, cardiopulmonary bypass and aortic clamp time, and extubation time). The standard anesthesiological management, myocardial protection techniques, and ventilator-weaning process were performed.

3. Procedure

All of the patients received the same, standard anesthesia technique and the median sternotomy approach was used. The perfusion temperature was allowed to decrease to 28°C during the CPB and the standard cold potassium cardioplegia solution was used for all of the patients, who were then transferred directly from the operating room to the cardiosurgery ICU (CSICU). All of the patients were mechanically ventilated on synchronized intermittent mandatory ventilation, with a tidal volume of 10–12 mL/kg, a respiratory rate of 10–12/min, and a fraction of inspired oxygen rate of 100%. The nurses evaluated the hemodynamic, neurological, and respiratory state of the patients. Once the patients were fully awake, if they met the extubation criteria, the nurse made the decision to extubate.

4. Variables and Data Analysis

The preoperative variables were defined as the age, sex, Body Mass Index value, documented hypertension, diabetes mellitus, cigarette smoking, opium or alcohol use. The intraoperative variables included the type of surgery, number of vessels grafted, duration of the aorta cross-clamp, duration of the CPB. Other variables, like the surgeon, anesthesiology technique, cardioplegia solution, and hypothermia were constant, so they were not tested. The length of intubation was calculated from the admission to the CSICU to the extubation time, in hours. The statistical methods included the use of descriptive analysis, the X^2 test, Fisher’s exact tests, and linear regression, with the extubation time as the dependent variable and the intraoperative variables as the independent variables.

5. Results

The demographic characteristics and preoperative variables of the subjects are summarized in Table 1. The patients were predominantly male (78.3%). The mean age of the sample was 55 years, with 12 patients who were >70 years old. At the time of the operation, 41 patients (68.3%) had hypertension, 22 (36.7%) had diabetes mellitus, 38 (63.3%) were smokers, and just six patients (10%) had a history of alcohol or opium usage.

Extubation was achieved for 60 patients in a mean time of 8,33±1,99 h, 18,3% of the patients were extubated in ≤6 h (n=11) and 81,7% of them were extubated in >6 h after surgery (n=49), which classified them into the early and delayed extubation groups, respectively. The X2 test showed no differences between the two groups regarding demographic characteristics. No patients in the early extubation group required reintubation (Table 1).

The aortic cross-clamping time ranged from 23–160 min, with a mean of 88,95±34,66 min. The mean time of the CPB was 150,88±51,49 min. The majority of patients had CABG (66,7%) surgery. The majority of the patients had three bypass grafts, ranging from one to six vessels. These intraoperative data are presented in Table 2. The linear regression was found a statistically significant relationship between the extubation time and the CPB time (r=0,27, p<0,05) and aortic cross clamping time (r=0,31, p<0,05). These results are summarized in Table 3.

Table 1. Demographic and preoperative variables (n = 60)

Characteristic	N	%	Mean	SD	Range
Age (years)			55	17,51	20-82
Sex					
Female	13	21,7			
Male	47	78,3			
BMI (kg/m^2)					
<20	3	5			
			27,6	4,19	17-36
20-30	40	66,6			
>30	17	28,4			
Hypertension					
Yes	41	68,3			
No	19	31,7			
Diabetes Mellitus					
Yes	22	36,7			
No	38	63,3			
Cigarette smoking					
Yes	38	63,3			
No	22	36,7			
Opium/alcohol usage					
Yes	6	10			
No	54	90			
Type of surgery					
CABG	40	66,7			
Valve Surgery	10	16,7			
ASD/VSD primer repair	6	10			
Bentall procedure	4	6,7			

BMI, Body Mass Index; SD, standard deviation.

Table 2. Descriptive statistics of the intraoperative variables

		Early Extubation ≤6 saat			Delayed Extubation >6 saat			Total		
				(n=11)			(n=49)			(n=60)
		N	%	Mean ± SD	N	%	Mean ± SD	N	%	Mean ± SD
Cardiopulmonary Bypass Time (min)		-	-	133,36 ± 63,30	-	-	154,81 ± 48,35	-	-	150,88 ± 51,49
Aortic Cross-clamping Time (min)		-	-	72,54 ± 39,77	-	-	92,63 ± 32,74	-	-	88,95 ± 34,66
Operation Time (h)		-	-	6,23 ± 1,54	-	-	6,81 ± 1,22	-	-	6,71 ± 1,29
Total Intubation Time (h)		-	-	5,54 ± 0,57	-	-	8,96 ± 1,61	-	-	8,33 ± 1,99
	CABG	5	45,5	-	35	71,4	-	40	66,7	-
Type of Surgery	Valve Surgery	2	18,2	-	8	16,3	-	10	16,7	-
	ASD/VSD	4	36,4	-	2	4,1	-	6	10,0	-
	Bentall	0	0,0	-	4	8,2	-	4	6,7	-
Number of Grafts		-	-	3,80 ± 0,83	-	-	3,28 ± 1,12	-	-	3,35 ± 1,15
	Yes	0	0,0	-	0	0,0	-	0	0,0	-
Reintubation	No	11	100,0	-	49	100,0	-	60	100,0	-

CABG, coronary artery bypass graft; ASD, atrial septal defect; VSD, ventricular septal defect.

Table 3. Intraoperative variables and extubation time

	Early Extubation ≤6 saat (n=11)	Delayed Extubation >6 saat (n=49)		
Variable	Mean ± SD	Mean ± SD	P-value	r
CPB time (min)	133,36 ± 63,30	154,81 ± 48,35	S*	0,27
Aortic Cross-klamping time (min)	72,54 ± 39,77	92,63 ± 32,74	S*	0,31
Operation time (h)	6,23 ± 1,54	6,81 ± 1,22	NS	
Number of grafts	3,80 ± 0,83	3,28 ± 1,12	NS	

*P<0.05; CPB, cardiopulmonary bypass; NS, not significant.

6. Discussion

With the rapid spread of the "fast-track" method, which has reduced the duration of early extubation and stay in intensive care, has shown that early-extubated patients have a significantly reduced duration of intensive care and hospitalization. Despite the fact that studies show that extubation in the operating room is well done, rapid changes in hemodynamic instability, changes in body temperature, mediastinal blood and fluid loss and other hemostatic disorders are expected in the first few hours postoperatively.

In this study of intraoperative variables and their effect on the extubation time after open heart surgery, five main areas emerged for further discussion: the type of surgery, number of grafts, operation time, duration of the CPB and cross-clamping of the aorta. The results illustrated that the duration of CPB and aortic cross-clamping had a significant effect on the extubation timing after a open heart surgery, with a longer CPB and aortic cross-clamping time causing a longer intubation time.

Konstantakos and Lee (2000) found that patients extubated in <4 h had a shorter aortic cross-clamping time (49.4±15.0 vs 53.5±14.0 min, P<0.05). Hence, some intraoperative variables might have an effect on the length of tracheal intubation after CABG surgery, like a shorter aortic cross-clamping time. Also, in the study of Reyes et al. (1997), successful early extubated patients had significantly shorter bypass and cross-clamping times (P<0.001).

In contrast, in some studies it was found no significant differences between the time of extubation and the length of cross-clamping of the aorta (Cheng et al., 1996; Knapik, Spyt, Richardson & McLellan, 1996). But, a different methodology was used in these studies. Also, some variables, such as anesthetic techniques that might affect the extubation time, were dissimilar in the early and delayed extubation groups.

Imanipour et al (2008), in their study, found that the CPB do not have a significant effect on the extubation time after CABG surgery (P=0.18). Maybe, this was because of the short CPB times (mean=63.73min); there was no patient with a CPB time of >120min. Bando, Sun, Binford and Sharp (1997) showed a mean CPB time of 155 min caused prolonged tracheal intubation. Moreover, Rady and Ryan (1999) found that patients with CPB times of >120min had a prolonged tracheal intubation period.

The CPB, especially, is known to activate inflammatory processing with resulting in rising pulmonary capillary permeability and damage to the lung parenchyma (Cox et al.). Also, after CPB, higher endothelin-1 levels were found in patients. Endothelin-1 is an endothelium-derived peptide that exerts strong vasoconstriction actions that are associated with an increase in the incidence of pulmonary edema and reperfusion injury of the lungs (Walthall & Ray, 2002; Imanipour et al., 2008). Cox et al. (2000) investigated whether the CPB time can affect pulmonary gas exchange. They found no significant difference in the pulmonary function between two groups with and without a CPB. But, they explained that this could be related to the sample size (n=52), with a mean CPB time of 74.3 min.

Walthall and Ray (2002) did not find any important difference between the extubation time and the CPB time. The findings of Knapik et al. (1996) are coherent with others: the length of the CPB had no significant effect on the tracheal extubation time after CABG. However, some studies showed that the CPB is significant to the extubation time when the length of the CPB is longer. Supporting this, Konstantakos and Lee (2000) found successful early extubation is possible in ≤4 h, which was achieved in patients with short CPB times.

There was no significant relationship between the number of vessel grafts and the duration of extubation in this study. Similarly, Konstantakos and Lee (2000) reported no significant relationship between the number of graft vessels and the duration of extubation in their studies.

7. Limitations

This study had several limitations. First, the sample size was too small. Tus, replication of the study with a larger sample would provide a more complete picture of the intraoperative variables that influence the duration of intubation following open heart surgery. Though the use of fixed protocols, like anesthetic management, surgical techniques, and myocardial protection strategies, enhanced the internal validity of our study, it limited the generalizability of our findings to other patients and settings.

8. Conclusion

It is necessary that practitioners and nurses who extubate patients after open heart surgery be conscious of intraoperative events and how these might affect tracheal extubation time in order to make safe decisions (Konstantakos & Lee, 2000; Walthall & Ray, 2002).

In this study, we found a statistically significant relationship between the CPB and aortic cross-clamping time with the extubation time. Hence, some intraoperative factors, like the CPB time and aortic cross-clamping time, might influence the chance of patients' earlier extubation. Therefore, due to the importance and benefits of early extubation in patients after open heart surgery, it is recommended that nurses consider the CPB and aortic cross-clamping time in their assessment of extubation timing.

References

Bojar, R. M. (2011). Respiratoy management. In: R.M. Bojar (Ed), *Manual of perioperative care in adult cardiac surgery*. (5th ed). Oxford: Blackwall.

Bowles, M. J. (2010). Mechanical ventilation after cardiac surgery. USA: Cella Publishing.

Camp, S. L., Stamou, S. C., Stiegel, R. M., Reames, M. K., Skipper, E. R., Madjarov, J. & Robicsek, F. (2009). Quality improvement program increases early tracheal extubation rate and decreases pulmonary complications and resource utilization after cardiac surgery. *Journal of Cardiac Surgery, 24*(4), 414-423.

Cheng, D. C., Karski, J., Peniston, C., Asokumar, B., Raveendran, G., Carroll, J. & Zelovitsky, J. (1996). Morbidity outcome in early versus conventional tracheal extubation after coronary artery bypass grafting: a prospective randomized controlled trial. *The Journal of Thoracic and Cardiovascular Surgery*, *112*(3), 755-764.

Cheng, D. C., Karski, J., Peniston, C., Raveendran, G., Asokumar, B., Carroll, J. & Sandler, A. (1996). Early tracheal extubation after coronary artery bypass graft surgery reduces costs and improves resource usea prospective, randomized, controlled trial. *The Journal of the American Society of Anesthesiologists, 85*(6), 1300-1310.

Cox, C. M., Ascione, R., Cohen, A. M., Davies, I. M., Ryder, I. G. & Angelini, G. D. (2000). Effect of cardiopulmonary bypass on pulmonary gas exchange: A prospective randomized study. *The Annals of Thoracic Surgery, 69*(1), 140-145.

Djaiani, G. N., Ali, M., Heinrich, L., Bruce, J., Carroll, J., Karski, J. & Cheng, D. C. (2001). Ultra-fast-track anesthetic technique facilitates operating room extubation in patients undergoing off-pump coronary revascularization surgery. *Journal of Cardiothoracic and Vascular Anesthesia, 15*(2), 152-157.

Doering, L. V. (1997). Relationship of age, sex and procedure type to extubation outcome after heart surgery. *Heart and Lung, 27,* 439–447.

Garg, R., Rao, S., John, C., Reddy, C., Hegde, R., Murthy, K. & Prakash, P. V. S. (2014). Extubation in the operating room after cardiac surgery in children: A prospective observational study with multidisciplinary coordinated approach. *Journal of Cardiothoracic and Vascular Anesthesia, 28*(3), 479-487.

Goodwin, M. J., Bissett, L., Mason, P., Kates, R. & Weber, J. (1999). Early extubation and early activity after open heart surgery. *Critical Care Nurse, 19,* 18–26.

Hamilton, B. C. S., Honjo, O., Alghamdi, A. A., Caldarone, C. A., Schwartz, S. M. & Van Arsdell, G. S. (2014). Efficacy of evolving early-extubation strategy on early postoperative functional recovery in pediatric open-heart surgery: a matched case-control study. *Seminars in Cardiothoracic Vascular Anesthesia, 18*(3), 290-296.

Hawkes, C., Foxcroft, D. R. & Yerrell, P. (2010). Clinical guideline for nurse-led early extubation after coronary artery bypass: an evaluation. *Journal of Advanced Nursing, 66*(9), 2038-2049.

Imanipour, M., Bassampoor, S. S. & Nikbakht-Nasrabadi, A. (2008). Intraoperative variables associated with extubation time in patients undergoing coronary artery bypass graft surgery. *Japan Journal of Nursing Science, 5*(1), 23-30.

Knapik, P., Spyt, T. J., Richardson, J. B. & McLellan, I. (1996). Bilateral and unilateral use of internal thoracic artery for myocardial revascularization: Comparison of extubation outcome and duration of hospital stay. *Chest, 109*(5), 1231-1233.

Konstantakos, A. K. & Lee, J. H. (2000). Optimizing timing of early extubation in coronary artery bypass surgery patients. *The Annals of Thoracic Surgery, 69*(6), 1842-1845.

Koyuncu, A., Yava, A., Kurkluogu, M., Guler, A. & Demirkilic, U. (2011). Mekanik ventilasyondan ayirma ve hemsirelik. *Turk Gogus Kalp Damar Cerrahisi Dergisi, 19*(4), 671-681.

Lee, T. W. & Jacobsohn, E. (2000). Pro: Tracheal extubation should occur routinely in the operating room after cardiac surgery. *Journal of Cardiothoracic and Vascular Anesthesia, 14*(5), 603-610.

Martin, C. G. & Turkelson, S. L. (2006). Nursing care of the patient undergoing coronary artery bypass grafting. *Journal of Cardiovascular Nursing, 21*(2), 109-117.

Rady, M. Y. & Ryan, T. (1999). Perioperative predictors of extubation failure and the effect on clinical outcome after cardiac surgery. *Critical Care Medicine, 27*(2), 340-347.

Reyes, A., Vega, G., Blancas, R., Morato, B., Moreno, J. L., Torrecilla, C. & Cereijo, E. (1997). Early vs conventional extubation after cardiac surgery with cardiopulmonary bypass. *Chest, 112*(1), 193-201.

Rodriguez-Blanco, Y. F., Candiotti, K., Gologorsky, A., Tang, F., Giquel, J., Barron, M. E. & Gologorsky, E. (2012). Factors which predict safe extubation in the operating room following cardiac surgery. *Journal of Cardiac Surgery, 27*(3), 275-280.

Roekaerts, P. M. & Heijmans, J. H. (2012). *Early postoperative care after cardiac surgery*. US: InTech.

Ibrahimoglu, O. (2017). Intraoperative variables associated with extubation time in patients undergoing open heart surgery. *New Trends and Issues Proceedings on Humanities and Social Sciences.* [Online]. 4(2), pp 237-244. Available from: www.prosoc.eu

Sacar, M., Onem, G., Adali, F., Goksin, I., Verdi, D. & Ozcan, A.V. (2008). Koroner arter bypass cerrahisi sonrasında gecikmis ekstubasyonun risk faktorleri. *Pamukale Tıp Dergisi, 1,* 26-31.

Sahinoglu, A. H. & Cinel, I. (2011). Mekanik ventilasyon: Genel ilkeleri, etkileri ve solunum modlari. Istanbul: Nobel Tip Kitabevi.

Uncu, H., Cagli, K., Goksel, S., Ulas, M. M., Yildiz, U., Korkmaz, K. & Tasdemir, O. (2004). Acik kalp cerrahisi sonrasi erken ekstubasyon; rutin islem olabilir mi?. *Ankara Universitesi Tip Fakultesi Mecmuasi, 57*(4), 223-231.

Walthall, H. & Ray, S. (2002). Do intraoperative variables have an effect on the timing of tracheal extubation after coronary artery bypass graft surgery?. *Heart & Lung: The Journal of Acute and Critical Care, 31*(6), 432-439.

Yeung, J. (2010). *Core topics in critical care medicine*. US: Cambridge University Press.