Factors Predicting Length of Hospital Stay among Patients with Open-Heart Surgery

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Abstract

Factors predicting the length of hospital stay among patients with open-heart surgery, basic information for use in the planning of care for postoperative heart patients to have higher quality and efficiency. This study was descriptive research with a retrospective methodology aimed at studying the factors predicting length of hospital stay in open-heart surgery patients. The sample was composed of 214 open-heart surgery patients who were purposively sampled based on set inclusion criteria. Data were collected from medical records in 2015 – 2016. Data were analyzed with descriptive statistics, Pearson's Product Moment Correlation and multiple linear regression.

According to the findings, the variables correlated with length of hospital stay in open-heart surgery patients with statistical significance were age, diabetes mellitus, coronary artery bypass surgery, urgency of surgery and cardiopulmonary bypass time. The factors capable of predicting length of hospital stay in open-heart surgery patients were urgency of surgery (beta = .22), cardiopulmonary bypass time (beta = .19) and age (beta = .16). All of the factors were able to co-predict fluctuations in length of hospital stay among open-heart surgery patients at 15 percent ($R2 = 0.15$, $F = 5.04$, $p < .001$). Therefore, elderly open-heart surgery patients who went into surgery urgently and had long cardiopulmonary bypass time should have special care models or close monitoring of symptoms to help reduce length of hospital stay in this group of patients.

Keywords: Factors Predicting, Length of Hospital Stay, Patients with Open-Heart Surgery

Introduction

Open-heart surgery is a treatment aimed at correcting congenital abnormalities of the heart and acquired heart disease. Trends of patients undergoing heart surgery are currently rising with most patients being adults and elderly people. According to statistics on heart surgery in Thailand, Thailand had 14,769 patients who underwent heart surgery in 2017 and this number increased to 15,368 patients in 2018 (The Society of Thoracic Surgeons of Thailand, 2017). According to Kijjanon & Get-kong (2009), who studied patients who had undergone open-heart surgery at a government hospital in which 69.50 percent of the patients were adult and elderly patients, open-heart surgery was found to have helped patients have good physical, psychological and social quality of life (Suwanakitch et al., 2019; Buttapim, Wanitkun, Sindhu & Kasemsarn, 2018; Sirisatheanrooch, Chittithavorn & Maneewat, 2012). However, patients who have undergone open-heart surgery may have post-operative complications resulting in longer intubation and ICU stays (Bohplian, 2014; Ranucci, Baryshnikova, Castelvecchio & Pelissero, 2013; Eltheni et al., 2012; Almashrafi, Elmontsri & Aylin, 2016; Azarfarin, Ashouri, Totonchi, Bakhshandeh & Yaghoubi, 2014), causing patients to have longer hospital stays and higher treatment costs.

The main indicator of care quality for patients who have undergone open-heart surgery is length of hospital stay at a mean of seven days (Hengcharoensuwan, Utriyaprasit, Sindhu & Laksanabunsong, 2010; Buttapim et al., 2018). According to a review of factors related to length of hospital stay among patients after open-heart

surgery domestically and abroad, the following two factors were involved: 1) Patients' factors such as gender, age, diabetes mellitus, ejection fraction and emergency hospital admission; and 2) Surgery factors consisting of type of surgery, Type of urgency, cardiopulmonary bypass time, duration of surgery, postoperative complications (Buttapim et al., 2018; Hengcharoensuwan et al., 2010; Fukfon, Wasee, Duangnakhorn & Akarawanasakun, 2018; Kijjanon & Getkong, 2009; Almashrafi, Alsabti, Mukaddirov, Balan & Aylin, 2016). Patients with long length of hospital stay were found to be more likely to have complications and higher treatment costs.

In Thailand, studies have been conducted on the factors related to length of hospital stay among patients in the intensive care unit. Most of the subjects were elderly patients who had received pre-planned coronary artery bypass surgery. However, currently, most of the patients who received open-heart surgery are adult and elderly patients. Few studies were conducted in Thailand. Therefore, the researcher's interest is in studying the factors predicting length of hospital stay among adult and elderly open-heart surgery patients to create baseline data for developing quality and more effective care models for open-heart surgery patients.

Research Objective – To study the factors predicting length of hospital stay in open-heart surgery patients.

Scope of the Study – This study is a retrospective research. Data were collected from patients' medical records. The population was patients who have undergone open-heart surgery at Kasemrad Hospital Prachachuen in 2015 – 2016.

Population and Sampling

The population was 600 patients who had open heart surgery at Kasemrat Prachachuen Hospital during 2015-2016 years. The sample of the study was open-heart surgery patient selected by means of purposive sampling with the following inclusion criteria: 1) they were 18 years old or older and 2) they were going into open-heart surgery for the first time. The site of this study was Kasemrat Prachachuen Hospital, a private tertiary hospital. The sample size was calculated using the G*Power 3.1.94 program and a sample size of 178 subjects increased by 20 percent, equal to 36 subjects, a total of 214 subjects. The researcher prepared a letter to the hospital director to ask for permission to collect data and explain research objectives. Data were collected from background files of patients with characteristics meeting designated criteria.
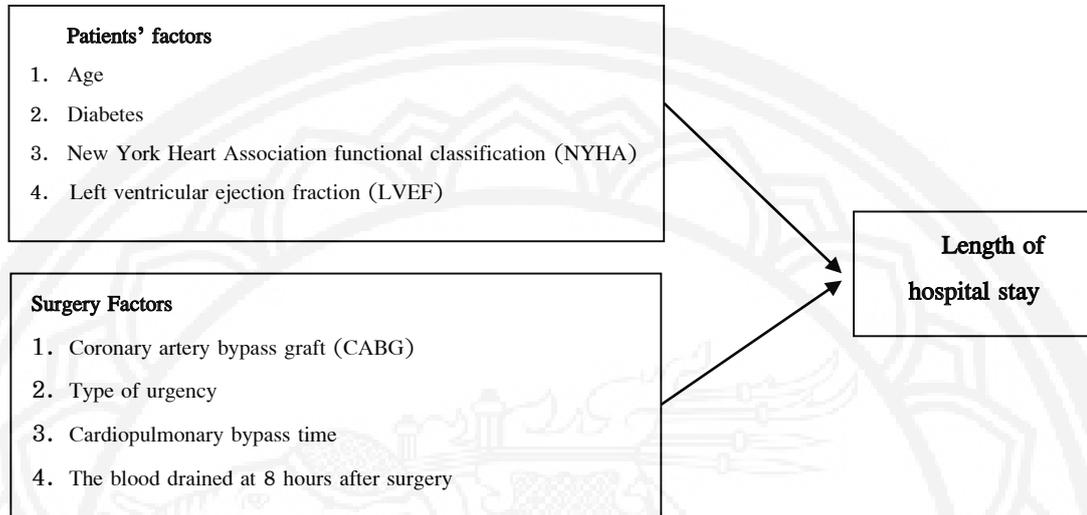
Ethical Considerations for the Population Studied – The researcher proposed the research project to the Institutional Review Board of Huachiew Chalermprakiet and received Confirmation No. อ.584/2560. The researcher then prepared a letter to request permission to conduct research and collect data from the hospital director. In collecting patients' privileged data, the researcher copied only data related to the study. Copied data were kept confidential and the findings are presented in group form.

Instrumentation and Instrument Quality Testing – The research instruments consisted of data collection forms created by the researcher from the literature review. Instruments were composed of two parts. Part 1 was for patients' factors and Part 2 was for surgery factors. Content validity testing was performed by three qualified experts consisting of a doctor with expertise in heart surgery, an anesthesiologist with expertise in anesthetizing heart surgery patients and a nurse with expertise in caring for heart surgery patients. Revisions were made according to recommendations and reliability was determined by testing and collecting data from patients' medical records. The instruments had Cronbach's Alpha Coefficient at 0.88.

Data Collection and Analysis

Patients' general and surgery data were analyzed by using a computer program and descriptive statistics to determine mean, standard deviation, frequency, percentage, Pearson's Product Moment Correlation and multiple logistic regression analysis.

Patients' factors

1. Age
2. Diabetes
3. New York Heart Association functional classification (NYHA)
4. Left ventricular ejection fraction (LVEF)

Surgery Factors

1. Coronary artery bypass graft (CABG)
2. Type of urgency
3. Cardiopulmonary bypass time
4. The blood drained at 8 hours after surgery

Length of hospital stay

Figure 1 Conceptual Framework

Patients' Factors – The subjects were found to have a mean age of 54.81 years (Min-Max = 31-78 years, S.D. = 11.22). The subjects (39.00%) had diabetes mellitus and a mean left ventricle ejection fraction of 55.82% (Min-Max = 15-84, S.D. = 15.29). Most of the patients (98.1%) had New York Heart Association classifications and most of the patients (47.70%) had heart capacity at NYHA Class III, followed by NYHA Class II (30.40%) and NYHA Class IV (20.10%), respectively.

Surgery Factors – Most of the patients were found to have undergone coronary artery bypass surgery (63.10%). Most of the patients' surgery urgency was as elective surgery (86.60%), followed by urgent surgery and emergency surgery (16.40%). The patients had a mean cardiopulmonary bypass time of 102.79 minutes (Min-Max = 11 – 130, S.D. = 34.15), a mean of 166.03 milliliters of blood drained at eight hours after surgery (Min-Max = 0 – 1,000, S.D. = 150.13) and a mean length of hospital stay of 7.35 days (Min-Max = 4 – 43 days, S.D. = 4.05).

Factors Predicting Length of Hospital Stay – Five variables were related to length of hospital stay in open-heart surgery patients with statistical significance. All of the variables were positively correlated with length of hospitalization. The variables consisted of age ($r = .18$, $p = .01$), diabetes mellitus ($r = .14$, $p = .04$), coronary artery bypass surgery ($r = .13$, $p = .05$), urgency of surgery ($r = .26$, $p = .00$) and cardiopulmonary bypass time ($r = .26$, $p = .00$). The variables unrelated to length of hospital stay were left ventricle ejection fraction, NYHA, amount of blood drained at eight hours after surgery as shown in Table 1.

When analyzed with multiple regression by the enter method, three factors were found to predict length of hospitalization among open-heart surgery patients consisting of cardiopulmonary bypass time, urgency of surgery and age. All of the factors were able to co-explain variances in length of hospital stay among open-heart surgery

patients at 15 percent (F = 5.04, p < .001). Urgency of surgery was able to explain fluctuation of length of hospital stay among open-heart surgery patients the most (beta = .22, p = .00), followed by cardiopulmonary bypass time (beta = .19, p = .01) and age (beta = .16, p = .03), respectively, as shown in Table 2.

Table 1 Factors associated with Length of Hospital Stay in Open-Heart Surgery Patients analyzed using Pearson's Product Moment Correlation (n=214)

Factors	Length of Hospital Stay	
	r	p
Patients' Factors		
1. Age	.18	.01**
2. Diabetes	.14	.04**
3. New York Heart Association functional classification	-.12	.09
4. Left ventricular ejection fraction	.06	.43
Surgery Factors		
5. Coronary artery bypass graft	.13	.05**
6. Type of urgency	.26	.00*
7. Cardiopulmonary bypass time	.26	.00*
8. The blood drained at 8 hours after surgery	.08	.21

*p<.001, ** p<.01, ***p<.05

Table 2 Multiple regression coefficient between predicted variables per hospital stay of open-heart surgery patients (n=214)

predicted variables	Unstandardized Coefficients		Beta	t
	B	S.E.		
- Age	0.06	0.03	0.16	2.23***
- Diabetes	0.56	0.58	0.07	0.96
- Type of urgency	2.42	0.72	0.22	3.36*
- Coronary artery bypass graft: CABG	-.48	.65	-.06	-0.72
- Cardiopulmonary bypass time	0.02	0.01	0.19	2.69**

Constant= 1.25, R square =0.14, Adjusted R=.12, F=5.60, p <.001

*p<.001, ** p<.01, ***p<.05

This study revealed open-heart surgery patients to have a mean length of stay of 7.35 days. Most of the patients had coronary artery bypass surgery. The findings concurred with Hengcharoensuwan et al. (2010) who studied the factors related to length of stay in adult and elderly patients who had undergone open-heart surgery and found the mean length of stay to be 7.30 days. Furthermore, the findings were in agreement with a study conducted by Osnabrugge et al. (2014) who found post-operative patients who had undergone heart surgery to have a mean length of hospital stay of 6.90 days. Moreover, low-risk patients were found to have a length of hospital stay of 5.40 days with 33,275 USD in costs. In addition, high-risk patients were found to have longer length of hospital stay at a mean of 13.8 days and higher costs at 69,122 USD. However, the findings were not in agreement with a study conducted by Fukfon et al. (2018) among adult and elderly patients who had undergone surgery at a government tertiary hospital. The patients had a mean length of hospital stay of 11.92 days, possibly because the context of this study was in a private hospital. The patients also had shorter time

spent waiting for surgery, causing less disease severity and fast recovery while patients incurred higher expenses than at government hospitals. Therefore, the organization enacted measures for the care of patients such as fast-track care guidelines, early weaning from mechanical ventilation and early patient rehabilitation to reduce patients' length of hospital stay.

Factors related to length of hospital stay among open-heart surgery patients consisted of personal factors such as age ($r = .18$, $p = .01$), diabetes ($r = .14$, $p = .04$), and surgery factors and post-operative factors such as coronary artery bypass surgery ($r = .13$, $p = .05$), urgency of surgery ($r = .26$, $p = .00$), cardiopulmonary bypass time ($r = .26$, $p = .00$). Factors predicting length of hospital stay in open-heart surgery patients consisted of cardiopulmonary bypass time, urgency of surgery and age.

Patients' factors such as age and diabetes mellitus were positively correlated with length of hospital stay in open-heart surgery patients and age was able to predict length of hospital stay in open-heart surgery patients. The findings concurred with Hengcharoensuwan et al. (2010); Azarfarin et al. (2014) and Almashrafi et al. (2016), possibly because the subjects in this study had a mean age of 55 years and were middle-aged with age-related degeneration and co-morbidities before surgery, causing patients to have lower functional status after open-heart surgery with causing patients to be at greater risk of complications than young patients. This concurred with a study conducted by Wairaree, Sindhu, Utriyaprasit and Slisatkorn (2017) who found age to be related to lower functional status after coronary artery bypass surgery. According to Hengcharoensuwan et al. (2010), older age was found to be related to longer length of hospital stay in open-heart surgery patients with statistical significance. In addition, Azarfarin et al. (2014) found age to be able to predict length of hospital stay ($B = .23$, $p < .001$).

Diabetes mellitus is a major pre-operative co-morbidity in patients. Although diabetes mellitus was unable to predict length of hospital stay in open-heart surgery patients, effects from cardiopulmonary bypass in post-operative open-heart surgery patients were found to have caused metabolic changes of carbohydrates with increased epinephrine secretion suppressing insulin secretion, causing glycogen metabolism in the liver and higher sugar, resulting in postoperative complications. This was in agreement with Poungsombut, Sindhu, Thosingha and Laksanabunsong (2012) who found diabetes mellitus to be a co-morbidity in patients correlated with postoperative complications in open-heart surgery patients. Complications such as Atrial fibrillation may have been detected because diabetic patients have chronically high blood sugar with hardened blood vessels and arteries in organs, reducing circulation to organs. In addition, higher postoperative blood sugar caused inconvenient circulation and caused the heart to work harder while wounds heal more slowly with chances of surgical wound infection.

Surgery factors consisting of coronary artery bypass surgery, urgency of surgery and cardiopulmonary bypass time were related to length of hospital stay. The factors predicting length of hospital stay in open-heart surgery patients were cardiopulmonary bypass time and urgency of surgery. The findings were able to explain the following:

Use of cardiopulmonary bypass during open-heart surgery may cause complications from lower mean blood pressure and circulation, administration of heparin as an anticoagulant, abnormally low body temperature which may cause the body's organs to deteriorate, bleeding from surgical wounds, cardiac arrhythmia and inflammation from contact with cardiopulmonary bypass equipment surface. Furthermore, patients may have lower blood circulation to organs. For example, less blood flow to the kidneys caused kidney damage and acute renal failure

after surgery in 5.8 percent of patients (Ng et al., 2014). According to Poungsombut et al. (2012), cardiopulmonary bypass time was correlated with length of hospital stay. The findings concurred with Almashrafi et al. (2016) who found patients who were on cardiopulmonary bypass to be related to length of hospital stay. Moreover, a study comparing between heart surgery patients who used cardiopulmonary bypass and heart surgery patients who did not use cardiopulmonary bypass (Kijjanon & Deebabangklong, 2013) found patients who did not use cardiopulmonary bypass to have fewer complications and shorter length of stay in the ICU and the hospital than patients who use cardiopulmonary bypass with statistical significance. In addition, the findings concurred with Azarfarin et al. (2014) who found cardiopulmonary bypass time to be able to predict length of hospital stay in open-heart surgery patients.

Regarding urgency of surgery, this study was conducted among patients who had elective surgery and emergency/urgent surgery. Patients who had emergency/urgent surgery were found to be related to length of hospital stay. This was consistent with Kijjanon & Getkong (2009) who found emergency hospital treatment to be related to length of hospital stay after open- heart surgery, possibly because patients who had emergency/urgent surgery had severe pathology of heart disease before surgery, causing cardiac functions initially after surgery to be lower. In addition, Widyastuti et al. (2012) found urgency of surgery to have effects on abnormal cardiac functions after open-heart surgery and urgency of surgery was found to be a factor capable of predicting renal complications after heart surgery (Ng et al., 2014). Furthermore, patients who had undergone emergency/urgent heart surgery may have less preparation before surgery than patients who had elective surgery on the topic of lung management and co-morbidity treatment, causing patients to have more post-operative complications and slow recovery.

Conclusion and Suggestions

The results of this study are useful empirical data for multidisciplinary teams to develop guidelines for pre-operative preparation. And postoperative care, specifically for patients with open heart surgery among elderly patients who have undergone urgent open-heart surgery and long cardiopulmonary bypass time. To prevent complications that may occur after surgery, patient safe and reduce the length of hospital stay, resulting in reduced expenses. And administrators can use the results of this study to guide the development of a multidisciplinary team in caring for patients undergoing heart surgery in order to increase the efficiency of caring for patients in the future.

This study was a retrospective study; therefore, it is impossible to study data on the occurrence of postoperative complications and problems caused by surgery. And studied in a single tertiary private hospital. Further studies should study the complications and other factors that affect the length of hospital stay. And conducted studies in many hospitals with different contexts in order to be able to refer to the results of referring patients undergoing open heart surgery in Thailand.

Acknowledgements

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