



Predictors of Prolonged Hospital Stay in Cardiac Surgery

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Abstract

The prolonged stay after cardiac surgery can significantly decrease the quality of life. Many studies have assessed the risk factors associated with length of stay but only a few have discussed the risk factors of prolonged stay after surgery. Therefore, this study is aimed to determine the risk factors affecting long term stay in hospital after CABG and to make comparison between group for each risk factors. All the risk factors were determined by Kaplan-Meier analysis. Overall, 3096 of CABG patients were discharged within less than 14 days, whereas 332 patients required prolonged (>14days) stays. The findings from the survival analysis indicated that patients with diabetes and wound infection stayed longer in the hospital.

Keywords: CABG, length of stay, prolonged stay, Kaplan-Meier analysis

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1.0 Introduction

Serious illness such as heart disease is a leading cause of death of people around the world (Mohammad *et al.*, 2008). Duration of stay in the hospitals require high treatment costs. The prolonged stay after cardiac surgery can significantly decrease the quality of life and increase overall hospital costs. Many studies have assessed the risk factors associated with length of stay after surgical treatment (Ono *et al.*, 2010 & Nawata *et al.*, 2009) but only a few have discussed the risk factors related to prolonged stay after surgery (Paul *et al.*, 2000 & Rony *et al.*, 2008). This study is aimed to : a) determine the risk factors affecting long term stay in hospital after CABG surgery, and b) make comparison between group for each risk factors. In order to do so, length of stay in hospital, age, sex, risk factors such as diabetes mellitus, hypertension, obesity, stroke and wound infection must be investigated.

2.0 Literature Review

The study of risk factors that affect the length of stay in hospital and its impact on resource utilization are reviewed by Yaseen *et al.* (2002). Length of stay of patients in hospital after CABG surgery was analyzed using a logistic regression model (Eric *et al.*, 2002). Multiple regression was used to analyse data for the patients survived surgery for perforated peptic ulcer (Li *et al.*, 2009). Jeroen *et al.* (2011) examined the factors that influence the risk of ICU stay after cardiac surgery using the Kaplan-Meier curves. The significance predictors were further examined by Cox %roportional Hazards Model. The same method is used by Paul *et al.* (2000) who study the prolonged stay of patients of mechanical ventilation after CABG surgery. Risk factors and comparisons of stay between sex for demented elderly was analysed using Cox Proportional Hazard Model with two types of scores of patients (Ono *et al.*, 2010).

Discrete proportional hazard model was used by Nawata *et al.* (2009) to study the length of stay for cataract patients in Japan. Rony *et al.*, (2008) focused on the risk factors influenced the prolonged stay in ICU after cardiac surgery using univariate and multivariate analysis. Longitudinal analysis was conducted to predict prolonged ICU stay due to hypertension following CABG surgery (Julie *et al.*, 2010). In this study, categorical variables was analysed using chi-square test. The study conducted by Girod *et al.* (2010) for improvement of the length of hospital stay 20T for free flap reconstructions of the oral cavity patients was analysed using Analysis of variance F. The difference in quality of life for two groups of gender was analysed using Mann Whitney test (Vladan *et al.*, 2010). The study found that sex structure is the factors that affected the quality of life after CABG surgery.

3.0 Methodology

3.1 Data and Statistical Analysis

This study included 3560 patients who received Coronary Artery Bypass Graft surgery (CABG) in the treatment of semi-government hospital, Malaysia for three years (200T-2010). Patient data comprised: the dates of operation and discharge from the hospital, birth, sex,

type of medical operations (CABG and valve surgery and combination of both), major risk factors (diabetes melitus, hypertension and obesity) and other clinical conditions (stroke and wound infection). Patients underwent valve and combination surgery were excluded in this study.

Data analysis was performed with SPSS version 1T software (SPSS Inc.4 Chicago4 IL4 USA). Length of stay was defined as the number of days from the operation date to the date of hospital discharge. Prolonged stay was defined as patients discharged more than 1= days after CA>G surgery (Yaseen *et al.*, 2002). Deaths were censored in the analysis. Kaplan-Meier method was used to estimate the survival curves. Log-Rank test was used to evaluate the difference between the curves. For *p*-value less than 0.10, variables were identified as significant. Two independent groups of sample data were compared by Mann-Whitney U test.

4.0 Findings and Analysis

Univariate Analysis

Table 1: Univariate Analysis of Patient Demographics and Postoperative factors

Variable	Number of patients (%)	Normal Stay (mean ± SD)	Prolonged stay	-value (log- rank test)	Median	-value (Mann- Whitney test)
Gender						
male	2936(85.65%)	10.T6±0.15	2T.5±1.135	0.90T	21	
female	492(14.35%)	11.39±0.391	28.01T±2.236		20	0.040
Age						
<T0	30TT(89.T6%)	10.T1±0.146	2T.884±1.135	0.444	21	
≥T0	351(10.24%)	12.13±0.481	26.109±2.186		20	0.000
Diabetes						
yes	1823(53.18%)	11.52±0.216	28.8±1.3T2	0.03	22	
no	1605(46.82%)	10.09±0.169	25.638±1.445		20	0.000
Hypertension						
yes	2835(82.T0%)	10.94±0.155	2T.466±1.104	0.93	21	
no	593(1T.30%)	10.45±0.325	28.2T5±2.5T9		20	0.000
Obesity						
yes	80(2.33%)	12.21±0.826	23.813±2.321	0.42T	20	
no	3348(9T.66%)	10.82±0.142	2T.T82±1.058		21	0.013

Stroke						
yes	9(%)	26.33±5.185	27.475±1.027	0.269	30	
no	3419(99.73%)	10.81±0.139	33.833±5.51		21	0.000
Wound Infection						
yes	189(5.51%)	24.06±1.516	35.412±2.258	0.000	28	
no	3239(94.49%)	10.08±0.104	24.122±0.987		20	0.000

Table 1 summarizes the univariate analysis of patients demographics and postoperative factors. 3428 patients underwent CABG surgery survived and were discharged from hospital. Among this cohort 492 (14.35%) were female patients and 2936 (85.65%) male patients with the average of normal stay 10.76 ± 0.15 days. The female patients stayed longer in the hospital compared to the male patients. The achieved results reported that for the average of normal stay in the hospital, patients with diabetes, hypertension, stroke and wound infection stay longer compared to normal patients with the same risk factors. This is proven by Mann-Whitney test U which all the factors (gender, age, diabetes, hypertension, obesity, stroke and wound infection) were significance ($p\text{-value} < 0.05$). In the context of prolonged stay in the hospital (>1 days) 4 patients age < 70 years 4 had diabetes 4 stroke and wound infections tend to have prolonged hospitalization than patients ≥ 70 years and without the same risk factors.

3.2 Multivariate Analysis

The analysis is further extended by dividing the study population according to gender categories of male and female patients (Table 2). Discussions began with a group of less than 70 years of age. Male group had the highest number of 2172 patients (74%) compared to 366 female patients who had hypertension and the difference is almost 7 times more than women. This trend is followed for other risk factors such as diabetes 1384 male patients (74.1%) than 266 female patients. The number of male patients for risk factors of obesity, stroke and wound infection were 4 to 7 times higher than female patients.

Table 2: Multivariate Analysis of Patient Demographics and Postoperative Factors

Gender	Age		Hypertension		Diabetes Mellitus		Obesity		Stroke		Wound Infection		Total
			No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	
Male	< 70	Total	482	2172	1270	1384	2596	58	2646	8	2526	128	2654
		%	16.4%	74.0%	43.3%	47.1%	88.4%	2.0%	90.1%	.3%	86.0%	4.4%	90.4%
	≥ 70	Total	46	236	151	131	279	3	282	0	256	26	282
		%	1.6%	8.0%	5.1%	4.5%	9.5%	.1%	9.6%	.0%	8.7%	.9%	9.6%
	Total	Total	528	2408	1421	1515	2875	61	2928	8	2782	154	2936
		%	18.0%	82.0%	48.4%	51.6%	97.9%	2.1%	99.7%	.3%	94.8%	5.2%	100.0%

Female	< T0	Total	5T	366	15T	266	405	18	423	0	392	31	423
		%	11.6%	T4.4%	31.9%	54.1%	82.3%	3.T%	86.0%	.0%	T9.T%	6.3%	86.0%
	ST0	Total	8	61	2T	42	68	1	68	1	65	4	69
		%	1.6%	12.4%	5.5%	8.5%	13.8%	.2%	13.8%	.2%	13.2%	.8%	14.0%
	Total	Total	65	42T	184	308	4T3	19	491	1	45T	35	492
		%	13.2%	86.8%	3T.4%	62.6%	96.1%	3.9%	99.8%	.2%	92.9%	T.1%	100.0%

Kaplan-Meier Analysis

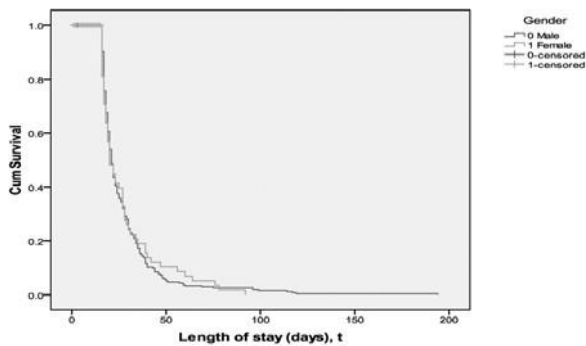


Figure 1: Survival Analysis for Each Gender

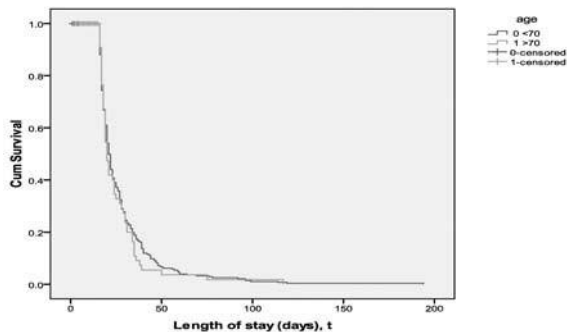


Figure 2: Survival Analysis for Two Age Groups

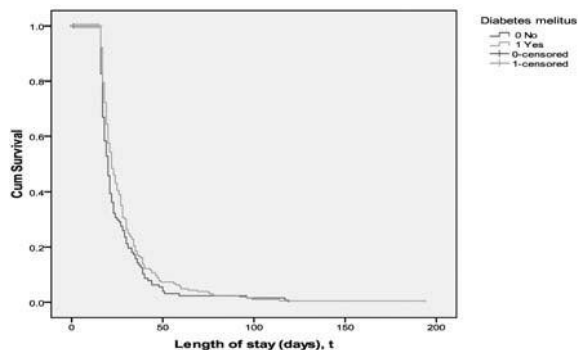
Figure 1 shows the survival curves for both gender groups who underwent CABG surgery. It was found that there are differences in survival between the two gender groups. The

survival curves for both gender were almost identical at the beginning of the study (4T days). After 4T days, the survival curve for female patients is higher than the male curve. From 96 days until the end of the study, only the survival curves for male patients can be seen. One possible reason could be there is no longer female patients who stayed in the same period. The results obtained from the log-rank test revealed no significant differences existed between the two gender groups where value of p is equal to 0.90T.

The survival curves showed (figure 2) that at the beginning of the study until 39 days, the survival function for patients aged T0 years above and below were almost identical. Between 40 days and 55 days, patients with aged more than T0 years (4.8%) stayed shorter period in the hospital than patients aged less than T0 years (3.3%). There were 1 patient of aged > T0 years and 3 patients of aged < T0 years required prolonged stay more than 100 days. Log-rank test showed that the p -value is 0.444 which is greater than 0.10. This shows that there is no significant difference between the two age groups. As a conclusion, age is not a risk factor that cause patients to stay longer in the hospital.

At the beginning of the study up to 99 days (figure 3)4 the survival function for patients with diabetes was higher than the non-diabetic patients. This shows that the diabetic patients (61.14%) required prolonged stay than the non-diabetic patients (3T.65%). From 90 to 194 days, only 2 patients for both categories received treatment in the hospital. We can conclude that there exists a difference for prolonged stay in hospital for both groups. It was justified by log-rank test (p -value = 0.059).

Dual plot in (figure =) describes the prognosis for the survival of hypertensive ($T=.T\%$) and non-hypertensive (12.95%) patients. In the first 39 days of the study, the two functions were almost identical. From 40 to 194 days, a total of 32 patients with hypertension required longer period of stay in hospital. P -value (0.93) showed no significant differences in length of stay existed between the two groups. This suggests that high blood pressure is not a risk factor affecting the long period stay in hospital.



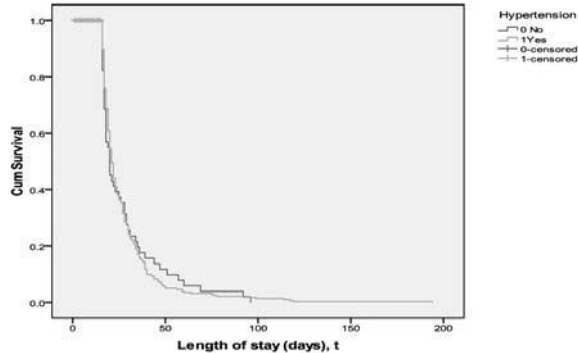


Figure 3: Survival Analysis for Diabetic and Non-Diabetic Patients

Figure 4: Survival Analysis for Hypertensive and Non-Hypertensive Patients

The three-year Kaplan-Meier analysis (figure 5) estimates the prolonged length of stay was 2=.10% for obese patients. In the first 28 days4 survival estimations for non-obese (66.8T%) and obese patients (4.21%) were identical. After 28 days until day-50, it was found that the non-obese stayed in the hospital in a shorter period of time compared to obese patients. The survival curves for patients with obesity can be seen until the end of the study. This could be due to there is no longer obese patients in the hospital during this period. *P*-value (0.=2T) verified that obese and non-obese patients did not show any significant differences for the prolonged stay in hospital.

The comparison of the prolonged stay in hospital between patients who experienced complication such as wound infection and patients without complication was significance (*p*-value 0.00). From beginning till the end of the study (figure 6)4 it was found that patients with complications (30.T0%) stayed longer in hospital. Survival analysis (figure T) clearly showed that4 until day-60, patients without the stroke complications required prolonged stay in hospital than patients who had a stroke after CABG surgery. However4 there is no significant difference (*p*-value = 0.269) of length of stay between the two groups.

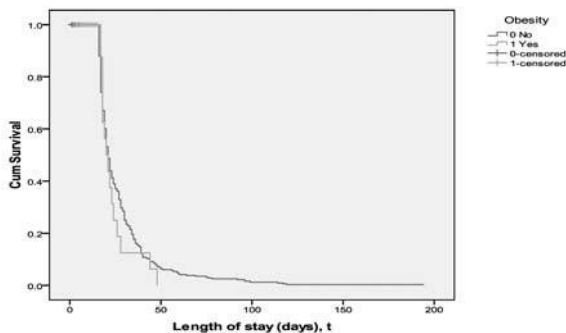


Figure 5: Survival Analysis for Obese and Non-Obese Patients

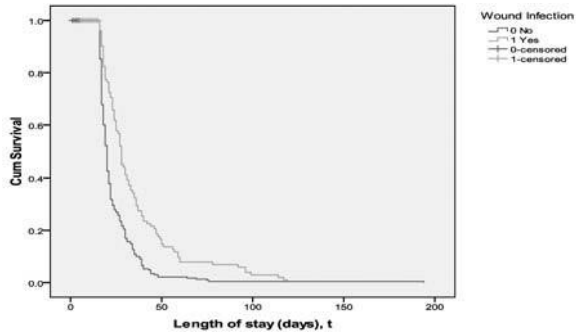


Figure 6: Survival Analysis for Patients with and without Complication (Wound Infection)

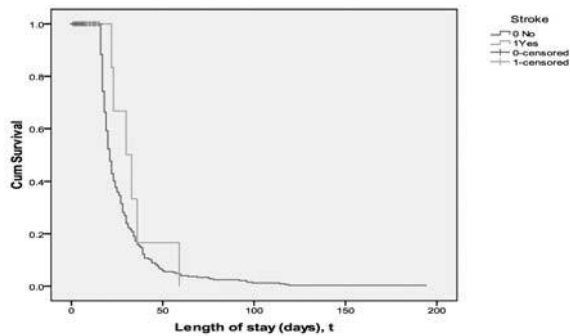


Figure T

4.0 Discussion

Risk Factors for Prolonged Stay After CABG Surgery

Descriptive statistics showed that 50% of male and female patients were hospitalized more than 14 days as for all the risk factors such as obesity, hypertension, diabetes and complications. From previous study, obesity was often associated with factors of stay in hospitals (Paul *et al.*, 2000). Age greater than 70 years is also a common factor for longer stay in hospital. This is evident from the Mann Whitney U test performed on cardiac patients in hospital. The average survival period of stay for comparison group of risk factors are similar to each other except for patients who had complications of wound infection. From the analysis, it is showed that male patients with stroke were more likely to have longer hospitalization period than female patients with stroke. This result is similar to Goto *et al.* (2007). Women is found to stay longer in the hospital compared to men (Paul *et al.*, 2000). Research shows that most of U.S. CABG patients stay in hospital for 5 days (Eric *et al.*, 2002). This is contradict to the study conducted by researcher where most of Asian CABG patients stay in hospital for 8 days. In the

preliminary univariate analysis, most of the patients stayed in the hospital for more than 14 days is more susceptible to complications.

4.1 Perspective of Future Impacts

Length of stay (LOS) factors (especially involving prolonged hospitalization) in hospital for patients undergone CABG has important roles in institution, health economic and clinical implication as it shows level of efficiency. Efficiency can be defined as the association between input and output system. For example, number of patients can be increased (output) due to availability number of beds (output) (Ine *et al.*, 2008). This means that the hospital management will be able to optimize the usage of availability resources and patients do not have to wait for long periods of time to be admitted to the hospital. It is reported that 30% of patients need to wait for admission in the hospital (Rony *et al.*, 2008). Therefore, time can be saved and the quality of services will be more effective. The increase of patients requires changes of management aspects, especially in surgery schedule and a daily of routine clinicals.

4.2 Quality of Life

From the analysis, it shows that the population of male patients 2936 (85.65%) is higher as compared to female patients 492 (14.35%). This might be due to the sensitivity of female patients to health care and by frequent consultation regarding their symptoms to health experts (Mechanic., 1976). It is believed that precaution taken by female patients have prevented them from experience decline in their health. Furthermore, it shows women had their therapeutic procedures effectively. This theory is the effects of biological and social factors (Vladan *et al.* 2010). However 4 findings proven that female patients spent more time in a hospital than male patients. This is due to age factor as female patients (14%) underwent CABG at older age compared to male patients (9.6%). Older patients required more time for recovery process as compared to younger ones. Male patients (88.89%) are more likely to suffer from stroke after CABG surgery compared to female patients (11.11%). Aortic atherosclerosis increase the risk factor of stroke (Tomoko *et al.*, 2007). Stroke directly proportional to high cholesterol level that corresponds to quality of life including lifestyle, daily diet and genetic factors.

5.0 Conclusion

Researcher faced with a few constraints when conducting this research. The variables used were very limited because the patients' data were strictly protected by the hospital for confidentially purposes. Survival analysis also has several problems such as the truncated data and the outcome variable is not normally distributed (Marubini, 2004). New statistical methods need to be studied to overcome this problem. All the risk factors studied influenced the hospital stay (gender, age, diabetes, hypertension, obesity, stroke and wound infection). Two independent factors such as diabetes and wound infection have been shown associated with a prolonged stay for the patients after surgery. Findings proven that longer stay after cardiac surgery can significantly decrease the quality of life. It is hoping that the identification

of these risk factors will help the health care institution to improve the quality of services while the community would realize the importance of healthy lifestyle.

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