

## ปัจจัยที่มีความสัมพันธ์กับภาวะหัวใจเต้นผิดจังหวะในผู้ป่วยผ่าตัดหัวใจ\*

จันจूरีย์ ยศดา\*\*

กุสุมา คุววัฒนสัมฤทธิ์\*\*\*

อภิญญา ศิริพิทยาคุณกิจ\*\*\*

### บทคัดย่อ

การวิจัยครั้งนี้เป็นใช้วิธีวิจัยเชิงบรรยาย เก็บข้อมูลจากเวชระเบียนบันทึกย้อนหลัง (Retrospective study) มีวัตถุประสงค์เพื่อศึกษาปัจจัยด้านร่างกาย ปัจจัยด้านการทำงานของหัวใจ และปัจจัยด้านการผ่าตัดกับการเกิดภาวะหัวใจเต้นผิดจังหวะในผู้ป่วยผ่าตัดหัวใจ และเพื่อศึกษาความสัมพันธ์ระหว่างปัจจัยด้านร่างกาย ปัจจัยด้านการทำงานของหัวใจ และปัจจัยด้านการผ่าตัดกับการเกิดภาวะหัวใจเต้นผิดจังหวะโดยรวบรวมข้อมูลจากเวชระเบียนประวัติการรักษาผู้ป่วย ของโรงพยาบาลรามาริบัติ ระหว่างเดือนมกราคม พ.ศ. 2555 ถึงธันวาคม พ.ศ. 2555 จำนวน 425 ราย วิเคราะห์ข้อมูลโดยการแจกแจงความถี่ ร้อยละ และการทดสอบ Chi-square and Fisher exact test

ผลการวิจัยพบว่า กลุ่มตัวอย่างที่เข้ารับการผ่าตัดหัวใจเกิดภาวะหัวใจเต้นผิดจังหวะ จำนวน 388 ราย (ร้อยละ 91.3) เป็นชนิด Premature ventricular contraction จำนวน 246 ราย (ร้อยละ 57.9) ชนิด Atrial fibrillation จำนวน 199 ราย (ร้อยละ 46.8 ) ชนิด Tachycardia จำนวน 181 ราย (ร้อยละ 42.6) ชนิด Premature atrial contraction จำนวน 177 ราย (ร้อยละ 41.6) ชนิด Ventricular tachycardia จำนวน 65 ราย (ร้อยละ 15.3) ชนิด Bradycardia จำนวน 54 ราย (ร้อยละ 12.7) ชนิด Ventricular fibrillation จำนวน 28 ราย (ร้อยละ 6.6) และชนิดอื่น ๆ จำนวน 63 ราย (ร้อยละ 14.8) ปัจจัยที่มีความสัมพันธ์กับภาวะหัวใจเต้นผิดจังหวะในผู้ป่วยผ่าตัดหัวใจ ทั้งลักษณะของคลื่นไฟฟ้าหัวใจก่อนการผ่าตัด ชนิดของการผ่าตัด และการใช้เครื่องหัวใจและปอดเทียม ระหว่างกลุ่มที่เกิดภาวะหัวใจเต้นผิดจังหวะและกลุ่มที่ไม่เกิดภาวะหัวใจเต้นผิดจังหวะ แตกต่างกันอย่างมีนัยสำคัญทางสถิติ ( $p < .01$ )

ข้อเสนอแนะ การศึกษานี้ให้ความรู้พื้นฐานในการเกิดหัวใจเต้นผิดจังหวะในผู้ป่วยหลังผ่าตัดหัวใจ และสามารถนำไปพัฒนาแนวทางปฏิบัติเพื่อป้องกันหัวใจเต้นผิดจังหวะในผู้ป่วยหลังผ่าตัดหัวใจที่มีความเสี่ยงสูงต่อไป

**คำสำคัญ:** หัวใจเต้นผิดจังหวะ, การผ่าตัดหัวใจ, การศึกษาย้อนหลัง

\*วิทยานิพนธ์ หลักสูตรพยาบาลศาสตรมหาบัณฑิต สาขาการพยาบาลผู้ใหญ่ โรงเรียนพยาบาลรามาริบัติ คณะแพทยศาสตร์โรงพยาบาลรามาริบัติ มหาวิทยาลัยมหิดล

\*\*นักศึกษาหลักสูตรพยาบาลศาสตรมหาบัณฑิต สาขาการพยาบาลผู้ใหญ่ โรงเรียนพยาบาลรามาริบัติ คณะแพทยศาสตร์โรงพยาบาลรามาริบัติ มหาวิทยาลัยมหิดล

Corresponding author; E-mail: yjanjuree\_p@hotmail.com

\*\*\*ผู้ช่วยศาสตราจารย์ โรงเรียนพยาบาลรามาริบัติ คณะแพทยศาสตร์โรงพยาบาลรามาริบัติ มหาวิทยาลัยมหิดล

## Factors related to arrhythmias in patients undergoing heart surgery\*

Janjuree Yotda\*\*

Kusuma Khuwatsamrit\*\*\*

Apinya Siripitayakunkit\*\*\*

### Abstract

This retrospective research aimed to explore physical, cardiac function and surgical factors with cardiac arrhythmia after heart surgery, and to study the relationship between physical, cardiac function, and surgical factors and cardiac arrhythmias after heart surgery. The data were derived from the medical records at Ramathibodi Hospital, Thailand from January 2012 to December 2012. A total number of 425 patients were selectively collected. Data were analyzed by using chi-square and Fisher exact test.

The result showed that patients after heart surgery developed cardiac arrhythmias were 388 (91.3%). Various types of cardiac arrhythmia were as follows: premature ventricular contraction 246 cases (57.9%), atrial fibrillation 199 cases (46.8%), tachycardia 181 cases (42.6%), premature atrial contraction 177 cases (41.6%), ventricular tachycardia 65 cases (15.3%), bradycardia 54 cases (12.7%), ventricular fibrillation 28 cases (6.6%), and others types 63 cases (14.8%). It concludes that preoperative EKG, types of operation and heart lung machine were significantly different between patients with cardiac arrhythmia and without cardiac arrhythmia after heart surgery ( $p < .01$ )

This study provided basic knowledge of cardiac arrhythmia after heart surgery and could help develop guideline to prevent cardiac arrhythmias after heart surgery in high-risk patients.

**Keywords:** cardiac arrhythmias, heart surgery, retrospective study

---

\*Thesis, Master of Nursing Science Program in Adult Nursing, Ramathibodi School of Nursing, Faculty of Medicine Ramathibodi Hospital, Mahidol University

\*\*Master Student, Master of Nursing Science Program in Adult Nursing, Ramathibodi School of Nursing, Faculty of Medicine Ramathibodi Hospital, Mahidol University

Corresponding author; E-mail: yjanjuree\_p@hotmail.com

\*\*\*Assistant Professor, Ramathibodi School of Nursing, Faculty of Medicine Ramathibodi Hospital, Mahidol University

Received: October 13, 2020 / Revised: July 8, 2021 / Accepted: December 1, 2021

## Introduction

Cardiovascular disease has been the top life-threatening disease of the world and the severe public health problem. The global status report indicated that the number of 17 million persons of cardiovascular disease were death annually<sup>1</sup>. In Thailand, cardiovascular disease was the fourth ranked cause of death and increase in number of 18,399 and 20,130 patients in 2010 and 2011. Although cardiovascular disease patients can be treated by medical and surgical treatment surgical treatment of cardiovascular disease patient was increased as 12,848 and 14,043 patients in 2011 and 2012 respectively<sup>2</sup>. The main target of heart surgery is to prevent sudden death, alleviate chest pain, and increase quality of life. At present, heart surgery can be performed extensively with satisfactory success. Even though surgery treatment is increased survival rate, it is at risk for complication also<sup>3</sup>. Heart surgery is the major surgery with risk of complication and death incidence after surgery especially during the first 24 hours, hemodynamic may be unstable<sup>4</sup>. If heart surgery patients have complication, they will delay recovery, longer length of stay in hospital and higher postoperative mortality rate<sup>5</sup>. The postoperative complications in heart surgery patients are different depending on risk factor of an individual. These complications are postoperative bleeding, cardiac tamponade, cardiac arrhythmia<sup>6</sup>, neurological complication<sup>7</sup>,

respiratory and lung system complication, renal system complication<sup>8</sup> and wound infection.

Cardiac arrhythmia was often detected post-heart surgery complication<sup>6,9</sup>. Cardiac arrhythmia incidence in post-coronary artery bypass grafting and in heart valve surgery patients were 10-40 percent and 40-70 percent, respectively. In addition, the occurrence of cardiac arrhythmia was on the second to the fourth postoperative day.<sup>10-12</sup> Atrial fibrillation was frequently occurred after heart surgery. Patient with cardiac arrhythmia after heart surgery was higher mortality rate than patient without cardiac arrhythmia after heart surgery<sup>10,13</sup>. Ventricular cardiac arrhythmias are also more fatal than atrial or junctional cardiac arrhythmias, particularly, ventricular tachycardia. This results in an increased hospital mortality 50 percent and up to 10 percent additional mortality in another two years.

The cause and mechanism of cardiac arrhythmia after heart surgery have not yet been obvious. Previous studies indicated that factors causing cardiac arrhythmia were age<sup>13-15</sup>, hypertension<sup>16, 17</sup>, cardiac failure, disorder of thyroid gland function<sup>18-20</sup>, valvular heart disease and myocardial infarction<sup>21</sup>, obesity<sup>18</sup>, diabetes<sup>21, 22</sup>, chronic obstructive lung disease<sup>1</sup> and electrolyte imbalance including low serum potassium level, and low serum magnesium level.<sup>21</sup>

Cardiac arrhythmia has been the significant complication in the heart surgery patients that should be monitored and prevented by the nurse and healthcare professional team to be occurred or when it occurs, it can be immediately treated. Therefore, in the first 24 hours after surgery, nurse should play the crucial role in monitoring the complications so that this condition can be rapidly cured. Most studies on factors related to cardiac arrhythmia incidence in the heart surgery patients were conducted in abroad.

In Thailand, few studies were conducted and some of the aforesaid factors have not yet been studied. Although previous studies focused particularly on factors related to just atrial fibrillation-type cardiac arrhythmia incidence there have been various types of cardiac arrhythmia that affect fatality with patients if they occur without treatment or delay in treatment. In addition, the characteristics of Thai and foreign patients have been different, possibly resulting in no incidence of cardiac arrhythmia by some factors. To address this gap in knowledge, the researcher is interested in studying factors related to arrhythmias in patients undergoing heart surgery. The characteristics of the patients are classified into physiological factors heart function factors and surgery factors under expectation that the result of this study can be applied in accompany with formulating the guideline for development of the caring form of heart disease patients who are

operated to monitor and reduce the contingent complications of heart surgery.

In this study, factors related to cardiac arrhythmia incidence in the heart surgery patients will be studied by classifying into physiological factors such as age, obesity, underlying disease history, serum potassium, serum magnesium, heart function factors such as left ventricular ejection fraction (LVEF) and preoperative electrocardiogram, and surgical factors such as type of surgery, the main heart valve, and the use of heart-lung machine.

### **Research Question**

1. What are the risk factors (physiological factors, heart function factors and surgical factors) for cardiac arrhythmia after heart surgery?
2. Are physiological factors, heart function factors and surgical factors related to cardiac arrhythmia after heart surgery?

### **Objectives of Research**

1. To study the risk factors of cardiac arrhythmia after heart surgery.
2. To study the relationship between physiological, heart function and surgical factors, and cardiac arrhythmia after heart surgery

### **Methods**

This retrospective study aims to examine physiological factors, heart function factors and surgery factors with cardiac

arrhythmia after heart surgery patients, and to study the relationship between physiological factors, heart function factors and surgery factors and cardiac arrhythmia after heart surgery patients at Ramathibodi Hospital, Bangkok, Thailand.

The populations in this study were the 425 patients who admitted for cardiac surgery, and they were admitted for coronary artery bypass grafting (CABG) and heart valve replacement or repair surgery, aged over 15 years old. The data were retrieved from Ramathibodi Hospital database (RDHC) between January 2012 and December 2012.

### **Research Instrument**

Part 1 Demographic Data consists of age, gender, height, weight, hospital admission date, hospital discharge date, and length of hospital stay.

Part 2 Physiological Factor is the selected factors related to cardiac arrhythmia in the following inclusion below.

1. Underlying disease history (diabetes, chronic obstructive lung disease, hypertension, and thyroid disease)

2. Weight and height are specified in number. BMI is calculated under two choices including below  $30 \text{ kg/m}^2$  and more than or equal to  $30 \text{ kg/m}^2$

3. Serum potassium and magnesium level refers to preoperative serum potassium and magnesium level and its level during postoperative arrhythmia.

4. Thyroid hormone level refers to preoperative serum T3, T4, TSH.

Part 3 Heart Function Factor is the selected factors including.

1. Left ventricular ejection fraction (LVEF) refers to the effectiveness of ventricular function. It is divided into  $\text{LVEF} \geq 40\%$  which is collected from preoperative phase.

2. Preoperative electrocardiogram (EKG) refers to electrical signal of cardiac cycle. It is divided into normal EKG and abnormal EKG. Abnormal EKG consisted of atrial and ventricle arrhythmia.

Part 4 Surgery Factor is the selected factors including.

1. Type of Surgery refers to coronary bypass graft surgery (CABG), heart valve replacement or repair, and combination of CABG and heart valve replacement. It is collected from the operative report.

2. The four main heart valve refers to the two atrioventricular valve and two semilunar valve which is operated by replacement or repair.

3. Used of heart lung machine refers to the requirement of used of heart lung machine during heart surgery and the duration of its used. It is divided into used and no used of heart lung machine and used  $\leq 2$  hours and  $> 2$  hours.

Part 5 Cardiac arrhythmia was the selected factors including as follow.

1. Postoperative arrhythmia and type of arrhythmias refers to cardiac arrhythmia occurring after heart surgery and the arrhythmias were at atrium or ventricle. Cardiac arrhythmias include atrial fibrillation, ventricular tachycardia, ventricular fibrillation, bradycardia, tachycardia, premature ventricular contraction, and other type.

2. First diagnosed of cardiac arrhythmia after heart surgery was collected from nurses' note.

3. Frequency of cardiac arrhythmia after heart surgery was collected from nurses' note on the 1<sup>st</sup> – 4<sup>th</sup> day after heart surgery.

4. A total number of days for occurring cardiac arrhythmia after heart surgery. It was collected from nurses' note.

5. Length of postoperative ICU stay was calculated from nurses' note.

#### **Validity of the instrument**

The researcher instruments were validated by 3 experts as follow: Physician expert in cardio-thoracic surgery 1 Person, nurse instructor in cardio-thoracic surgery 1 Person, and nurse expert in cardiovascular unit 1 Person. The researcher revised the instruments follow the content from all experts with content validity index (CVI) = .94

#### **Protection of human subjects**

Ethical approval was obtained from the Human Research Review Committee of the Faculty of Medicine Ramathibodi Hospital,

Mahidol University (No.MURA2015/198). Written permission was obtained from the direction of Ramathibodi Hospital for data collection. All participants were assured that their data would be kept confidentially. The results of this study were represented as whole, and they were not named.

#### **Data Analysis**

The researcher determined data code and prepared note coding manual and then took those data for analysis using package software. The analysis procedure is as follows. Physiological factor, Heart function factor and Surgery factor data analyzed using descriptive statistics. The relationship between physiological factors, heart function factors, surgery factors and cardiac arrhythmias after heart surgery was analyzed using Chi square test and Fisher exact test.

#### **Result**

##### **Population characteristics**

There were 425 patients after heart surgery from January 2012 and December 2012 and most patients were male in ratio between male and female patients of 1.6:1 with average age of 60.49 years (SD = 13.9). The samples showed average length of stay in critical care unit of 6.18 days (SD = 4.97; median 5 days) and had totally average admitted day in the hospital for 17.76 days (SD = 15.34; median 14 days). 388 patients (91.3%) who had cardiac arrhythmia after heart

surgery. This number is comprised as follows: ventricular contraction (57.9%), atrial fibrillation (46.8%), tachycardia (42.6%), premature atrial contraction (41.6%), ventricular tachycardia (15.3%), bradycardia (12.7%), ventricular fibrillation (6.6%) and other types (14.8%).

The population characteristics of the total 425 patients presented are shown in Table 1 factors age, obesity, underlying diseases, serum potassium level, serum magnesium level, left ventricular ejection fraction and the four main heart valves between the group with cardiac arrhythmia and without cardiac arrhythmia in patients after heart surgery, were not statistically significant difference ( $p > .05$ ) as shown in table 1.

#### **The risk factors of cardiac arrhythmia after heart surgery**

According to the comparison of number and percent of selected factors of heart functions, the result showed that the group with left ventricular ejection fraction more than or equal to 40% included 377 patients (88.7%), among of which, 344 patients had arrhythmia (91.2%) and 33 patients did not have arrhythmia (8.8%). Meanwhile, the group with left ventricular ejection fraction was less than 40% with 48 patients (11.3%) and the results demonstrated that 4 patients had arrhythmia (91.7%) whereas 4 patients were without this condition (8.3%). Left ventricular ejection fraction between the group with arrhythmia and without arrhythmia was not statistically

significant distinction with  $p > .05$ . The samples with electrocardiogram in normal sinus rhythm were 205 patients (48.2%). In this group, 179 patients had arrhythmia (87.3%) and 26 patients did not have arrhythmia (12.7%). Moreover, this study found that 220 patients had abnormal electrocardiogram before surgery (51.8%) which 209 patients had arrhythmia (95%) and 11 patients did not have arrhythmia (5%). The abnormal electrocardiogram before surgery between patients with arrhythmia and patients did not have arrhythmia was statistically significant different with  $p < .01$  as shown in table 2.

#### **The relationship between physiological, heart function and surgical factors, and cardiac arrhythmia after heart surgery.**

It has been shown that among 252 samples (59.3%) had coronary artery bypass graft surgery (CABG). 217 patients had arrhythmia (86.1%) while the other 35 patients did not have arrhythmia (13.9%). For the group with heart valve replacement of 134 patients (31.5%), 132 patients had arrhythmia after heart surgery (98.5%) while other 2 patients did not have arrhythmia (1.5%). Meanwhile, the group with CABG and heart valve replacement had arrhythmia included 39 patients (100%). The results found that type of surgery between patients with arrhythmia and patients without arrhythmia was statistically significant difference ( $p < .01$ ).

According to the study, the results showed as follow 1) 268 samples (63.1%) used heart lung machine. 2) 254 patients had arrhythmia (94.7%). 3) 14 patients did not have arrhythmia (5.2%). Meanwhile, in the group without using heart lung machine including 157 patients (36.9%), 134 patients had arrhythmia (85.3%) while the other 23 patients did not have arrhythmia (14.6%). Conclusively, the use heart lung machine between patients with arrhythmia and without cardiac arrhythmia was statistically significant difference ( $p < .01$ ). as shown in table 2.

**Table 1** The characteristics of the participants (n=425)

Variable	Arrhythmia Number (percent)		X <sup>2</sup> /Fisher	p-value
	No	Yes		
<b>Age</b>				
<60 years	21 (12.4)	149 (87.6)	4.008	.45
≥60 years	16 (6.3)	239 (93.7)		
<b>Obesity</b>				
BMI <30kg/m <sup>2</sup>	31 (7.9)	363 (92.1)	0.42*	-
BMI ≥ 30 kg/m <sup>2</sup>	6 (19.4)	25 (80.6)		
<b>Diabetes</b>				
No	24 (8.6)	255 (91.4)	0.00	1.00
Yes	13 (8.9)	133 (91.1)		
<b>COPD</b>				
No	37 (9)	374 (91)	0.622*	-
Yes	0	14 (100)		
<b>Hypertension</b>				
No	12 (8.2)	135 (91.8)	0.012	.914
Yes	25 (9)	253 (91)		
<b>Thyroid disease</b>				
No	34 (8.3)	376 (91.7)	0.133*	-
Yes	3 (20)	12 (80)		
<b>Serum Potassium</b>				
< 3.5 mmol/L	1 (3.4)	28 (96.6)	2.04	.36
3.5-5 mmol/L	36 (9.3)	351(90.7)		
>5 mmol/L	0	9 (100)		
<b>Serum Magnesium</b>				
<1.3 mmol/L	0	3 (100)	0.308	.857
1.3-2.2 mmol/L	35 (8.8)	362 (91.2)		
>2.2 mmol/L	2 (8)	23 (92)		

\*Use Fisher exact test



**Table 2** The relationship of heart function factors and surgery factors with cardiac arrhythmia after heart surgical (n=425)

Variable	Arrhythmia Number (Percent)		X <sup>2</sup> /Fisher	p-value
	No	Yes		
<b>Heart function</b>				
<b>LVEF</b>				
≥40 %	33 (8.8)	344 (91.2)	1.00*	-
< 40 %	4 (8.3)	44 (91.7)		
<b>Preoperative EKG</b>				
Normal sinus rhythm	26 (12.7)	179 (87.3)	6.944	.008**
Abnormal	11(5.0)	209(95.0)		
<b>Surgery factors</b>				
<b>Type of surgery</b>				
CABG	35 (13.9)	217 (86.1)	21.009	<.001**
Valve	2 (1.5)	132 (98.5)		
CABG + Valve	0	39 (100)		
<b>Four main heart valve</b>				
Mitral valve	92 (98.9)	1 (1.1)	22.566	.012
Aortic valve	47 (100)	0		
Tricuspid valve	7 (100)	0		
Pulmonic valve	6 (85.7)	1 (14.3)		
<b>Used of heart lung machine</b>				
Yes	14 (5.2)	254 (94.7)	9.477	.002**
No	23 (14.6)	134 (85.3)		

LVEF = Left ventricular ejection fraction, EKG = Electrocardiogram, CABG = Coronary artery bypass graft,

\*Use Fisher exact test, \*\*p < .01

## Discussion

Heart function factor includes preoperative electrocardiogram. Cardiac arrhythmia after heart surgery in patient with preoperative abnormal EKG was significantly different among patient with normal EKG.

Electrocardiogram could indicate heartbeat, size of heart chamber, some heart diseases or even myocardial infarction. If electrocardiogram is abnormal, it can predict which position has abnormal cardiac electric conduction in patient's heart. Abnormal electrical conduction

of the heart is showed by EKG. It concludes that if patients have abnormal electrocardiogram in atrial fibrillation before heart surgery, they are at risk of having arrhythmia.<sup>6</sup>

Surgical factors include types of surgery and the use of heart lung machine. Types of surgery are divided as coronary artery bypass graft surgery, heart valve replacement or reparation and bypassing together with heart valve reparation or replacement. This study showed that cardiac arrhythmia after heart surgery was significantly different between CABG, valve surgery, and combine CABG and valve surgery. This is associated with the previous study that CABG and valve surgery were important factors related to cardiac arrhythmia after heart surgery<sup>10,11,12</sup>.

Furthermore, this study was associated with other studies that showed that CABG was 86.1 percent of cardiac arrhythmia after heart surgery and CABG combined with cardiac valve replacement was 98.5 percent of cardiac arrhythmia after heart surgery.<sup>10,13</sup> In addition, cardiac arrhythmias after heart surgery were atrial fibrillation, premature beats, tachydysrhythmias and bradydysrhythmias. Multiple procedures of heart surgery take long time of peri operation which in turn result in cardiac muscle more exposed to injury and lead to affect both atrium and ventricle contraction.<sup>17-</sup>

<sup>19</sup> Cardiac conduction system is also interfered which can cause cardiac arrhythmias.

Moreover, cardiac arrhythmia affects circulatory system failure which causes low perfusion. Therefore, patients after heart surgery are at risk of myocardial ischemia, stroke, heart failure and death.<sup>15-17, 21-22</sup>

In conclusion, factors affecting arrhythmia in patients with heart surgery are preoperative electrocardiogram, type of surgery and the use of heart lung machine. Therefore, roles of nurses in preparing patients before operation and monitoring after operation are essential. Ongoing observation and assessment are needed to prevent potential cardiac arrhythmia.

### **Limitations**

Although the current study is based on a small sample of participants, the findings suggest that it would be useful to use as a base through which to compare to other contexts of studies, which in turn provide a guideline for managing factors related to arrhythmias in patients undergoing heart surgery.

### **Suggestions and implementation**

These findings have significant suggestion and implementation for the understanding of how basic knowledge of cardiac arrhythmia after heart surgery could help develop guideline to prevent cardiac arrhythmias after heart surgery in high-risk patients. Taken together, these results provide insights for high-risk patients with heart surgery which should have cardiac telemetry monitoring

for 24-72 hours. These findings also suggest a role for nurses in developing preoperative checklist to detect cardiac arrhythmia.

### Recommendations

Further research should be undertaken to explore how other factors of cardiac arrhythmia such as inotropic drugs use, antiarrhythmic drugs use, blood transfusion after surgery should be further explored in prospective study. This would be a fruitful area for further work of screening program for high risk of post operative cardiac arrhythmia to improve quality of care and prevent further complications.

### References

1. Al-Sarraf N, Thalib L, Hughes A, Tolan M, Young V, McGovern E. Effect of preoperative atrial fibrillation on postoperative outcome following cardiac surgery. *Cardiol Res Pract.* 2012;10:1-7.
2. Al-Zaru IM, Ammouri, AA, Al-Hassan MA, Amr AA. Risk factor for deep sternal wound infections after cardiac surgery in Jordan. *J Clin Nurs.* 2010;19:1873-81.
3. Anthony A, Senedlbach S. Postoperative Complications of coronary artery bypass grafting surgery. *Crit Care Nurs Clin North Am.* 2007;19:403-15.
4. Smeltzer SC, Bare BG. Brunner and Suddarth's Textbook of Medical-Surgical Nursing 2004; Vol.1 (10thed.). Philadelphia: Lippincott Williams & Wilkins. Smeltzer SC, Bare BG, Hinkle JL, Cheever KH. Management of patient with complications from heart disease. In Brunner and Suddarth's Textbook of Medical-Surgical Nursing. 11th ed. Philadelphia (US): Lippincott Williams & Wilkins; 2008. p. 944-73
5. Hareyan A. Complication after cardiac surgery increase hospital costs. *Ann Thorac Cardiovasc Surg* [Internet]. 2008. Retrieved June 19, 2013, Available from <http://www.pnewsire.com/news-releases/complications-after-cardiac-surgery-increase-hospital-costs-length-of-stay-by-more-than-two-thirds-57477017.html>.
6. Kalavrouziotis D, Buth JK, Ali SI. The impact new onset atrial fibrillation on in hospital mortality following cardiac surgery. *Chest.* 2007; 131:833-9.
7. Franco KL, Verrier ED. Advanced therapy in cardiac surgery. 2nd ed. London (UK); 2003.
8. Chaiyaroj S. Complications and pitfalls of coronary artery bypass grafting. In Rattanaolan K, Ueanoraset J, Loetsitthichai P, Suwanthamma V. (Eds.) *Complication and pitfalls in surgery.* Bangkok (TH): Wetchasan. 2008;133-7. (in Thai).
9. Sayasathit J. *Common cardiac surgery* 1st ed. Phitsanulok (TH): Global Print; 2012.(in Thai).
10. Hashemzadeh K, Dehdilani M, Dehdilani M. Postoperative atrial fibrillation following open cardiac surgery: Predisposing factors and complications. *J Cardiovasc Thorac Res.* 2013; 5(3):101-7.
11. Helgadottir S, Sigurdsson MI, Ingvarsdottir IL, Amar DO, Gudbjartsson T. Atrial fibrillation following cardiac surgery: risk analysis and long-term survival. *J Cardiothorac Surg.* 2012; 7:1-7.
12. Nair SG. Atrial fibrillation after cardiac surgery. *Ann Card Anaesth.* 2010;13:196-205.
13. Maesen B, Nijs J, Maessen J, Alessie M, Schotten U. Post-operative atrial fibrillation: a maze of mechanisms. *Eur Heart J.* 2011; 14:159-74.

14. Gorczyca-Michta I, Wozakowska-Kalon B, Tomasik E. Prevalence and predisposing conditions for atrial fibrillation in hospitalised patients with hypertension. *Kardiol Pol.* 2013; 71(4):352-8.
15. Sutheeraphattharanon S. Atrial fibrillation: an update. In internal medicine Rajavithi Hospital, current concepts and update treatment (2). 1st ed. Bangkok (TH): Print City; 2008. (in Thai).
16. Srirattanasathavorn C. Atrial fibrillation (Overview). In Panchawinin P, Kritiyaphong R, Phankingthongkham R (Eds.). *Practical cardiology.* Nonthaburi (TH): Parbpim ; 2012. p.237-43. (in Thai).
17. Boonyaphisit V. Management: Rate control versus rhythm control strategy. In Panchawinin P, Kritiyaphong R, Phankingthongkham R. (Eds.). *Practical cardiology.* Nonthaburi (TH): Parbpim; 2012. p. 244-71.
18. Magnani JW, Hylek EM, Apovian CM. Obesity begets atrial fibrillation: A contemporary summary. *Circ Genom Precis Med.* 2013;128(4):401-5.
19. El-Chami MF, Sawaya FJ, Kilgo P, William IV, Halkos M, Thourani V, et al. Ventricular arrhythmia after cardiac surgery: incidence, predictors, and outcomes. *J Am Coll Cardio.* 2012; 60: 2664-71.
20. Lin Y, Li H, Lan X, Chen X, Zhang A, Li Z. Mechanism of and therapeutic strategy for atrial fibrillation associated with diabetes mellitus. *Sci World J.* 2013; 2013:209428. doi: 10.1155/2013/209428. Epub 2013 Mar 14. PMID: 23576900; PMCID: PMC3612491.
21. Peretto G, Durante A, Limite LR, Cianflone D. Postoperative arrhythmias after cardiac surgery: Incidence, risk factors, and therapeutic management. *Cardiol Res Pract.* 2014;10:1-5.
22. Jones B. Postoperative complications of cardiac surgery and nursing interventions. In Hardin SR, Kaplow R. (Eds.), *Cardiac surgery essential for critical care nursing.* Boston (US): Jone and Bartlett; 2010. p. 257-78.

๙๙๙ ๙๙๙ ๙๙๙ ๙๙๙ ๙๙๙