Incidence of Perioperative Myocardial Infarction among High Risk Patients Who Undergo Preoperative Evaluation for Non-Cardiac Surgery by Cardiologists

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Background*: High risk patients who undergo a non-cardiac surgery often develop a perioperative myocardial infarction (PMI).*
Objective*: To study the incidence of PMI among high risk patients who undergo preoperative evaluation for non-cardiac surgery by cardiologists.*
Material and Method*: This study was a cross-sectional study, performed at Thammasat Hospital for one year. Eligible patients were subjects older than 40 years with pre-existing cardiovascular disease or with at least one major cardiovascular risk factor including chronic kidney disease who underwent non-cardiac surgery with preoperative cardiovascular evaluation. The primary outcome is perioperative myocardial infarction.*
Results*: Fifty-three patients (mean age 70.5 years, 54.7% female) were eligible for the study. Most of these patients underwent orthopedic surgery (24 patients, 45.3%) and general surgery (18 patients, 34%). Four female patients developed PMI, representing the incidence of 7.5 percent. Chronic kidney disease and peripheral arterial disease were statistically significant associated with PMI.*
Conclusion*: The incidence of PMI in this study was slightly higher than those reported in previous studies. Therefore, physicians should be aware of the diagnosis and proper management of this condition.*

Keywords: *Perioperative myocardial infarction, Incidence, Preoperative evaluation, Non-cardiac surgery*

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Nowadays, the incidence of coronary artery disease is increasing particularly in some high risk populations such as those who suffer from diabetes, hyperlipidemia, peripheral vascular disease and also people who smoke. These risk factors will finally cause sudden heart attacks in a decade. In that case, approximately one fourth of all myocardial infarctions are silent, without chest pain or other symptoms[1]. Likewise, these high risk populations who would undergo non-cardiac surgery possibly develop a perioperative myocardial infarction. Although the reported incidence of perioperative myocardial infarction ranges from 3% to 6% among people who are older than 40 years and have some coronary risk factors[2-4], these number may be underestimated as about half of the patients do not present any symptoms such as chest pain or shortness of breath[5]. These misdiagnosed silent myocardial infarction cases may experience increased mortality rates in the near future. In addition, the detection of a perioperative myocardial injury can now be facilitated by measuring serum markers of myocardial injury such as troponin T or troponin I. These markers would accurately identify some silent myocardial infarction cases during and after surgical operations[6,7]. A perioperative myocardial infarction is an important prognostic factor as it has an effect on the short and long term prognosis of the patients[8-10]. As a result, prevention and early detection of this condition would enable these high risk populations to have better chances of receiving proper treatments without any delay.

After an implication of the current ACC/AHA 2007 perioperative guideline, the perioperative myocardial infarction incidence is decreasing to 4 percent[11]. Therefore, a standard preoperative evaluation before performing surgical operations might

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significantly decrease the incidence of a perioperative myocardial infarction and lead to more efficient utilization of health care resources for these high risk patients in Thailand.

This research is conducted to study the incidence of a perioperative myocardial infarction among high cardiovascular risk patients who undergo preoperative evaluations for non-cardiac surgery by cardiologist.

Material and Method

This study was performed at Thammasat Hospital during October 2008 to October 2009. Every patients who was recruited in this study must be assessed a preoperative evaluation from a cardiac physician and undergo a non-cardiac surgery.

Patients were eligible for this study if they were older than 40 years, and with at least one comorbid condition including a prior history of coronary artery disease (CAD), a prior heart failure, a prior history of cerebrovascular disease (CVA), diabetes (DM) and chronic kidney disease (CKD). This study excluded patients who had these conditions including acute coronary syndrome (ACS), 7 to 30 days post-diagnosed acute myocardial infarction (AMI), uncontrolled heart failure, significant stenotic valvular heart disease, conditions requiring emergency surgical procedures, and patients unwilling to participate.

Patients recruited into this study were interviewed and their medical records reviewed to obtain important information regarding personal information, functional capacity, coronary risk factors data, laboratory results and types of surgical operation. Then the patients were assessed and managed before undergoing surgery according to the ACC/AHA 2007 Guidelines on perioperative cardiovascular evaluation and care for non-cardiac surgery[11]. After the surgery was finished, an electrocardiogram and serum troponin-T were obtained immediately and were repeated again at 24 hours after surgery.

Regarding the definition of perioperative myocardial infarction (PMI), we adopt a universal definition of myocardial infarction described by ESC/ACCF/AHA/WHF 2007 to assess a primary outcome in this study[12]. However, previous clinical trials have uncertainly defined the timing of the perioperative period as within twenty-four hours after surgery or later. For this study, we use a twenty-four hour period as in previous studies to assess the incidence of PMI. Data were described usinge means and standard deviations (SD) for numerical variables and frequencies and percentages for be categorical variables. Associations between PMI and various clinical factors were examined using Chi-sqaure and Fisher's exact tests. A p-value of less than 0.05 was regarded as statistically significant.

Results

During this study period, there were 53 patients undergoing non-cardiac surgery who were eligible for this study. These patients were evaluated preoperatively by cardiologists. The mean $\pm$ SD age of patients in this study was 70.5 $\pm$ 10.3 years and 54.7% were female. The majority of patients (72%) were older than 65 years (Table1). These patients underwent seven different types of non-cardiac surgery, listed here in decreasing in frequency from orthopedics surgery (24 patients), general surgery (18 patients), vascular surgery (5 patients), urological surgery (2 patients), eye surgery (2 patients), ear nose throat (ENT) surgery (1 patient) to breast surgery (1 patient), respectively. Only 4 percent of patients had more than two clinical risk factors including a prior history of coronary artery disease (CAD), a prior heart failure, a prior history of cerebrovascular disease (CVA), diabetes (DM), chronic kidney disease (CKD) and approximately 6 percent of patients underwent a high risk surgery including a vascular surgery (Table 2).

Table 1. Shows baseline characteristic data of the patients

	Mean	Std Error of Mean	Std. Deviation
Age (yr)	70.51	1.411	10.271
Troponin-T (immediately postoperative)	0.02169	0.006155	0.043959
Troponin-T (at 24 hrs postoperative)	0.0195	0.00495	0.03501
EF% (preop)	67.7083	1.93787	9.49361

EF (preop) = left ventricular ejection fraction (preoperative)
Troponin-T was shown in ng/dl

Four female patients were diagnosed with perioperative myocardial infarction (PMI), representing the incidence of perioperative myocardial infarction (PMI) of 7.5% (95% confidence interval 3.0% to 17.9%) and the mean age of this group of patients was 80.25 ± 6.8 years (Table 3). According to their coronary risks,

Table 2. Shows the relationship between the perioperative myocardial infarction and baseline clinical risk factors in these group of patients

Risk factor		MI				p-value
		No = 49		Yes = 4		
		number	percent	number	percent	
Age group						
	< 65 yr	15	30. 61	0	0.00	0.17
	65-75 yr	19	38.78	1	25.00	
	> 75 yr	15	30.61	3	75.00	
Sex	Female	25	51.02	4	100.00	0.12
	Male	24	48.98	0	0.00	
CAD	No	35	71.43	4	100.00	0.56
	Yes	14	28.57	0	0.00	
CVA/TIA	No	38	77.55	3	75.00	1.00
	Yes	11	22.45	1	25.00	
CHF	No	47	95.92	3	75.00	0.21
	Yes	2	4.08	1	25.00	
CKD	No	40	81.63	1	25.00	0.03
	Yes	9	18.37	3	75.00	
DM	No	15	30.61	2	50.00	0.59
	Yes	34	69.39	2	50.00	
PAD	No	46	93.88	2	50.00	0.04
	Yes	3	6.12	2	50.00	
FH of CAD	No	46	93.88	4	100.00	1.00
	Yes	3	6.12	0	0.00	
HT	No	6	12.24	2	50.00	0.10
	Yes	43	87.76	2	50.00	
DLP	No	17	34.69	0	0.00	0.29
	Yes	32	65.31	4	100.00	
Smoker	No	33	67.35	4	100.00	0.30
	Yes	16	32.65	0	0.00	
Surgical risk	Intermediate	43	87.76	3	75.00	0.44
	High	3	6.12	0	0.00	
	Low	3	6.12	1	25.00	
ECG (preop)	Normal	31	63.27	3	75.00	1.00
	Abnormal	18	36.73	1	25.00	
Risk number	1-2	47	95.92	4	100.00	1.00
	> 2	2	4.08	0	0.00	
FC > 4 METS	No	3	6.12	0	0.00	0.35
	Yes	38	77.55	2	50.00	
	Unknown	8	16.33	2	50.00	
Surgery	General surgery	15	30.61	3	75.00	0.11
	Non-general surgery	34	69.39	1	25.00	

CAD = coronary artery disease, CVA/TIA = cerebrovascular disease/transient ischemic attack, CHF = congestive heart failure, CKD = chronic kidney disease, DM = diabetes, PAD = peripheral arterial disease, FH of CAD = family history of coronary artery disease, HT = hypertension, DLP = dyslipidemia, ECG = electrocardiogram, FC = functional capacity, MI = myocardial infarction Non-general surgery = orthopedics, ENT, urological, vascular, eye and breast surgery

they had 1 or 2 clinical risk factors but none of them had a known history of coronary artery disease (Table 4). One patient developed cardiogenic shock with multiple organ failure but she recovered within several weeks. The level of rise of troponin-T were 60% and 100% in the two female patients; however the troponin-T level of the rest was not increasing. Interestingly, general surgery was the most frequent type of surgery which leaded to PMI in this study. Furthermore, all of the four patients who developed PMI had no angina pectoris. In other words, all of them had a silent myocardial infarction during the perioperative period.

In comparison, none of male patients had a diagnosis of PMI, despite their higher coronary risk profiles than female patients. Nevertheless, the average age of female patients in this study was higher than that of male patients, rendering them at higher coronary risks than male patients in this study.

Among various clinical risk factors, only chronic kidney disease (CKD) (p-value 0.03) and peripheral arterial disease (PAD) (p-value 0.04) were found to be statistically significantly associated with perioperative myocardial infarction.

The number of clinical risk factors (2 or less vs. more than 2) and functional capacity (4 METS or less vs. greater than 4 METS) were not statistically significantly associated with perioperative myocardial infarction.

Discussion

This study provides the estimate of incidence of perioperative myocardial infarction in a population of Thai patients undergoing non-cardiac surgery with preoperative evaluation, as represented by this sample of patients treated in Thammasat Hospital. The incidence of 7.5% is slightly higher than those reported

Table 3. Shows a comparison of mean age between PMI patients and non-PMI patients in this study

	MI	n	Mean	Std. Deviation	Std. Error Mean
Age (yr)	No	49	69.71	10.141	1.449
	Yes	4	80.25	6.801	3.400

Table 4. Shows baseline characteristic data of the four patients who developed PMI

	Patient no. 1	Patient no. 2	Patient no. 3	Patient no. 4
Age (yr)	73	85	87	76
Gender	Female	Female	Female	Female
Clinal risk factors				
CAD	no	no	no	no
CVD/TIA	no	yes	no	no
CHF	no	yes	no	no
CKD	no	no	yes	yes
DM	yes	no	no	yes
Clinical risk no.	2	2	1	2
Other risk factors				
PAD	yes	no	no	yes
HT	no	no	yes	yes
Family hx of CAD	no	no	no	no
Dyslipidemia	yes	yes	yes	yes
Smoking	no	no	no	no
Functional capacity > 4 METS	unknown	yes	yes	unknown
EKG (preop)	normal	normal	normal	abnormal
Anginal symptom	no	no	no	no
Surgical risk	low	intermediate	intermediate	intermediate
Surgical type	general	general	general	orthopedics

from other previous studies. Even though the sample size is smaller than the calculated value which was demonstrated in the appendix, all of the study patients were recruited and qualified by the study inclusion criteria. Also, some recruited patients were excluded from this study because of their missing outcome data at postoperative period. Thus, this is the primary reason which leads to the insufficient sample size.

Among several clinical risk factors, chronic kidney disease (CKD) and peripheral arterial disease (PAD) were found to be statistically significantly associated with perioperative myocardial infarction (PMI). Because this data has relied on a small sample size, it might have an insufficient power to identify the other important clinical risk factors which were possibly statistically significant. In the future, the larger population will be recruited and a further study might discover the appropriate clinical risk factors which are used as surrogate markers for PMI.

Hence, the use of the current perioperative guideline for an elective non-cardiac surgery is possibly defective in physician practice, because the incidence of PMI is still high. From this study, the data shows that the four primary outcomes were silent myocardial infarctions which have no episode of angina pectoris as a warning symptom. Therefore, it is difficult to do an early detection to these group of patients. To sum up, we could possibly assume that the perioperative myocardial infarction is an underestimated condition in real practice and physicians will need a lot more studies to find out the most effective clinical predictors for the perioperative myocardial infarction in the future.

Conclusion

The perioperative myocardial infarction incidence in this research was slightly higher than previous clinical trials. In the future, the preoperative evaluation guideline should be adjusted to lessen the incidence of perioperative myocardial infarction in the patients.

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การศึกษาอุบัติการณ์ของการเกิดภาวะกล้ามเนื้อหัวใจตายระหว่าง และภายหลังการผ่าตัดที่ไม่ใช่การผ่าตัดหัวใจในผู้ป่วยที่ได้ผ่านการประเมินก่อนการผ่าตัดโดยอายุรแพทยโรคหัวใจ

อิงอร อรุณากูร, ดิลก ภิยโยทัย

ภูมิหลัง: *สำหรับผู้ป่วยที่เข้ารับการผ่าตัดที่ไม่ใช่การผ่าตัดหัวใจนั้น พบว่ามีความเสี่ยงที่จะเกิดภาวะกล้ามเนื้อหัวใจตายระหว่างและภายหลังการผ่าตัดได้บ่อย โดยเฉพาะอย่างยิ่งในผู้ป่วยที่มีความเสี่ยงสูงต่อการเกิด โรคหลอดเลือดหัวใจอุดตันอยู่ก่อน*

วัตถุประสงค์: *เพื่อที่จะทราบถึงอุบัติการณ์ของการเกิดภาวะกล้ามเนื้อหัวใจตายระหว่าง และภายหลังการผ่าตัดในประชากรกลุ่มที่มีความเสี่ยงสูงต่อการเกิดโรคหลอดเลือดหัวใจอุดตัน ที่ได้ผ่านการประเมินก่อนการผ่าตัดโดยแพทย์เฉพาะทางโรคหัวใจแล้ว*

วัสดุและวิธีการ: *ได้ทำการศึกษากับผู้ป่วย ณ โรงพยาบาลธรรมศาสตร์ เฉลิมพระเกียรติ ในช่วงระยะเวลา 1 ปีเต็ม โดยผู้ป่วย ที่ได้รับการ คัดเลือกจะต้องเป็นผู้ป่วยที่มีอายุมากเกินกว่า 40 ปีขึ้นไป รวมทั้งต้องมีโรคของหัวใจและหลอดเลือด เป็นโรคประจำตัว หรือมีอย่างน้อย 1 โรค ที่จัดเป็นโรคที่เสี่ยงต่อการเกิดโรคหลอดเลือดหัวใจอุดตัน ได้แก่ โรคไตวายเรื้อรัง โดยที่ผู้ป่วยจะได้รับการประเมินดูแลก่อนการผ่าตัดซึ่งมิใช่การผ่าตัดทางหัวใจ ผลลัพธ์หลักที่ต้องการศึกษาได้แก่ อุบัติการณ์ของการเกิดภาวะกล้ามเนื้อหัวใจตายระหว่างและภายหลังการผ่าตัด*

ผลการศึกษา: *พบว่ามีผู้ป่วยที่เข้าร่วมการศึกษาทั้งสิ้น 53 คน (มีอายุเฉลี่ย 70.5 ปี และเป็นผู้ป่วยหญิงจำนวน 54.7%) ผู้ป่วยส่วนใหญ่เข้ารับการผ่าตัดทางกระดูกและข้อ (24ราย, 45.3%,) และผ่าตัดทางศัลยกรรมทั่วไป (18 ราย, 34%) ในจำนวนนี้พบผู้ป่วยที่เกิดภาวะกล้ามเนื้อหัวใจตายระหว่างและภายหลังการผ่าตัด 4 คน โดยเป็นเพศหญิง ทั้งหมด ทำให้คำนวณอุบัติการณ์ได้เป็น 7.5 เปอร์เซ็นต์ นอกจากนี้ยังพบว่าโรคไตวายเรื้อรัง (chronic kidney disease) และโรคหลอดเลือดส่วนปลายตีบตัน (peripheral arterial disease) ยังเป็นปัจจัยเสี่ยงที่มีนัยสำคัญทางสถิติต่อการเกิดภาวะกล้ามเนื้อหัวใจตายระหว่างและภายหลังการผ่าตัด*

สรุป: *ในการศึกษาครั้งนี้พบว่ามีอุบัติการณ์ของการเกิดภาวะกล้ามเนื้อหัวใจตายระหว่าง และภายหลังการผ่าตัดค่อนข้างสูงกว่าการศึกษาที่ผ่านมาในต่างประเทศ จึงควรให้ความสำคัญกับการวินิจฉัยภาวะนี้ให้ได้มากขึ้น ซึ่งจะนำไปสู่การรักษาผู้ป่วยที่ดีขึ้นในอนาคต*