Factors Related to 24-Hour Perioperative Cardiac Arrest in Geriatric Patients in a Thai University Hospital

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Background: *As a site of the Thai Anesthesia Incidents Study (THAI Study) of anesthetic adverse outcome, the authors continued the institutional data collection to determine the incidence and factors related to 24-hour perioperative cardiac arrest in geriatric patients (aged 65 years and over) representing a Thai university hospital.*

Material and Method: *Between July 1, 2003 and March 31, 2007, an anesthesia registry was conducted at King Chulalongkorn Memorial Hospital. Anesthesiologists and anesthesia residents were requested to record perioperative variables and adverse outcomes including 24-hour perioperative cardiac arrest on a structural data record form. Univariable analysis was used to identify factors related to 24-hour perioperative cardiac arrest. A multivariable generalized linear regression for risk ratio was used to investigate independent factors with significant association to 24-hour perioperative cardiac arrest. A forward stepwise algorithm was chosen. A p-value < 0.05 was considered as statistically significant.*

Results: *Among 54,419 cases in the registry, 8,905 geriatric patients underwent a non-cardiac surgery under anesthesia. Thirty-six patients experienced cardiac arrest. The incidence of intra-operative cardiac arrest, within 24 hours postoperative cardiac arrest, and overall 24-hours perioperative cardiac arrest were 18:10000 (mortality rate of 62.5%), 22.5:10000 (mortality rate of 90%), and 40.4:10000 (mortality rate of 77.8%), respectively. By multivariable analysis, age of 76-85 [RR 2.6 (95% CI: 1.2,5.4)], age $\geq$ 86 [RR 4.4 (95% CI: 1.7, 11.8)], recent respiratory failure [RR 6.6 (95% CI: 1.9, 22.3)], ASA physical status 3-5 [RR 19.9 (95% CI: 4.6, 86)], emergency surgery [RR 2.8 (95% CI: 1.4, 5.6)], intrathoracic surgery [RR 3.7 (95% CI: 1.4, 9.9)], upper abdominal surgery [RR 2.8 (95% CI: 1.3, 5.7)], and administration of ketamine [RR 5.4 (95%CI: 1.8, 15.9)] were factors related to 24-hour perioperative cardiac arrest.*

Conclusion: *The incidence of 24-hour perioperative cardiac arrest of geriatric patients in a Thai university in the present study was 40.4:10000 anesthetics, which was comparable to others with high mortality rate. Risk factors for 24-hour perioperative cardiac arrest were older age, ASA physical status 3-5, emergency surgery, intrathoracic surgery, upper abdominal surgery, recent respiratory failure, and administration of ketamine. Pre-anesthetic evaluation is important for finding the risks and optimal preparation for preventing perioperative cardiac arrest in these aging patients.*

Keywords: *Adverse effects, Aged, Anesthesia, Geriatrics, Cardiac arrest, Intraoperative complications, Mortality, Postoperative complications, Registry, Risk factors, Patient safety*

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People aged 65 years and over are 10.3% of the Thai population[1]. Because this patient population is more likely to require operations, the growth in anesthesia and surgery is expected to outpace the population growth over the next decade. This is particularly true in the specialties that care for a greater proportion of geriatric patients such as cardiothoracic surgery, urology, and ophthalmology[2]. The increasing number of elderly patients who require surgical interventions creates a need to more clearly understand the implications for the practice of anesthesia with this subpopulation.

In the United States, the operative mortality has decreased in surgical patients who are more than 65 years, possibly because of advances in surgical procedures and anesthetic techniques[2-4], but perioperative morbidity continues to be more frequent. Manku et al[4] reported that 21% of geriatric patients undergoing surgery developed one or more postoperative complications[5]. Perioperative and postoperative complications in geriatric patients are common and may be severe in some cases. Age, in and of itself, may not be a risk factor for postoperative complications. The underlying comorbidities that develop as part of the aging process are risk factors[6]. Furthermore, limited functional capacity and recovery ability of the elderly patient also increase risk of perioperative complications. Several studies reported the postoperative complications in this group of patients such as oxygen desaturation[7], pulmonary embolism[8], pulmonary aspiration[9], cardiac arrest[10], and death[11]. The 24-hour perioperative cardiac arrest in geriatrics surgical patients is one of the most serious complications, because it can lead to fatal outcome or others serious morbidity.

Since 2003, the Royal College of Anesthesiologists of Thailand has hosted the Thai Anesthesia Incidents Study (THAI Study). This study revealed the average incidence of 24-hour perioperative cardiac arrest was 28.3:10000 anesthetics[12]. As a site of the multi-centered study, the registry of anesthesia service was continued at the Department of Anesthesiology, Faculty of Medicine, Chulalongkorn University. The aim of the present study was to investigate the incidence and factors related to 24-hour perioperative cardiac arrest in geriatric surgical patients receiving anesthesia in a university hospital, in Thailand.

Material and Method

The Royal College of Anesthesiologists of Thailand hosted the Thai Anesthesia Incidents Study (THAI Study) of anesthetic adverse outcomes was a prospective, multi-centered registry of consecutive anesthesia performed in 20 hospitals, during 2003 and 2004. As a site of this multi-center study, the registry of anesthesia was continued at the Department of Anesthesiology, Faculty of Medicine, Chulalongkorn University. The present study was approved by the ethics committee of the Faculty of Medicine, Chulalongkorn University. The basic design of the present study was a registry of anesthesia service, i.e. all consecutive patients who received anesthesia for non-cardiac surgery at King Chulalongkorn Memorial Hospital, a 1,500-bed university hospital.

During the period from July 1, 2003 to March 31, 2007, for each geriatric surgical patient who received anesthesia, an anesthesiologist or anesthesia resident completed a preplanned structured data entry form (Form1) including a series of variables related to the patient's profile, surgical procedure, and anesthesia technique. For in-patients, within the first 24 hours after the surgical procedure, the anesthesia resident or nurse anesthetist visited the patient to complete the 24-hour anesthesia record for any adverse outcomes. Whenever, 24-hour perioperative cardiac arrest (intraoperative to 24-hour postoperative period) in geriatric patients occurred, the details of events were recorded in a data entry form.

For the purpose of subsequent analysis, timing of adverse events was divided into three periods: intraoperative, postanesthesia care period (in the recovery room or post anesthesia care unit: PACU) and 24-hour postoperative period (within 24-hour after the operation). The adverse outcome of interest in the present study was 24-hour perioperative cardiac arrest in patients aged 65 years and over. The 24-hour perioperative cardiac arrest was defined as an event requiring cardiopulmonary resuscitation within 24-hour postoperative. The present study analyzed the database of 8,905 geriatric surgical patients receiving anesthesia care at King Chulalongkorn Memorial Hospital.

Data collection and analysis

All Form1 information collected during the study period were entered at the data management center with double entry technique to ensure the reliability of the database. With this prospective data collection, a retrospective analysis was performed. Descriptive statistics were used for analyses of the demographic data. Chi-square test or Fisher's exact test was used to compare categorical variable while t-test

or Wilcoxon's rank-sum test was used to analyze continuous data. Univariable analysis was used to identify factors related to 24-hour perioperative cardiac arrest. A multivariable generalized linear regression for risk ratio was used to investigate independent factors with significant association to 24-hour perioperative cardiac arrest. A forward stepwise algorithm was chosen. At each step, independent variables not yet included in the equation were tested for possible inclusion. The variables with the significant contribution ($p < 0.05$) to improve the model were also included. The variables that were already included in the equation were tested for exclusion on the basis of the probability of a log likelihood test ratio. The analyses ended when no further variables for inclusion or exclusion were available. A P value of less than 0.05 was considered as statistically significant.

Results

During the 45 months of the present study, there were 36 geriatric patients who developed perioperative cardiac arrest within 24-hour. Perioperative cardiac arrest occurred in 19 (52.8%) female and 17 (47.2%) male patients with a total incidence of 40.4:10,000 anesthetics. Mean (SD) and maximum age of these perioperative cardiac arrest patients were 77.9 (7.6) and 93 years old, while mean (SD) and maximum age of non-perioperative cardiac arrest patients were 73.2 (6.3) and 104 years old respectively.

Among the 36 patients of 24-hour perioperative cardiac arrest, 16 developed cardiac arrest during intraoperative period with the intraoperative mortality rate of 62.5% (10 out of 16 patients). There was one patient who developed cardiac arrest during the post-anesthesia care period with no fatality. In addition, 20 patients developed cardiac arrest during 24-hour postoperative period with mortality rate of 90% (18 out of 20 patients). Most of 24-hour perioperative cardiac arrest patients, 35 out of 36 cases underwent surgery with general anesthesia technique, while another case received monitor anesthesia care.

The demographic, surgical, and anesthetic characteristics of geriatric patients are demonstrated in Table 1 and Table 2. From univariate analysis, the present study revealed that age ($p < 0.001$), neuromuscular disease ($p = 0.003$), hematological disease ($p < 0.001$), miscellaneous disease ($p < 0.001$), recent respiratory failure ($p < 0.001$), congestive heart failure ($p = 0.006$), ischemia heart disease ($p = 0.003$), shock/impending shock ($p < 0.001$), arrhythmia ($p = 0.001$), anemia ($p < 0.001$), coagulopathy ($p < 0.001$), electrolyte imbalance/acid-base imbalance ($p < 0.001$), alteration of conscious ($p < 0.001$), sepsis ($p < 0.001$), renal insufficiency ($p = 0.036$), history of post cardiac arrest ($p < 0.001$), increased ASA Physical status ($p < 0.001$), emergency surgery ($p < 0.001$), intrathoracic surgery ($p < 0.001$), upper abdominal surgery ($p < 0.001$), and anesthetic technique ($p = 0.002$) were statistically significant factors.

The anesthetic agents used during anesthesia which significantly related to 24-hour perioperative cardiac arrest by univariate analysis were pentothal ($p = 0.043$), propofol ($p = 0.021$), ketamine ($p < 0.001$), midazolam ($p < 0.001$), pancuronium ($p = 0.003$), rocuronium ($p = 0.007$), nitrous oxide ($p = 0.015$), and prostigmine ($p = 0.004$).

From multivariate analysis, the present study found that ASA physical status 3-5 ($p < 0.001$), age 76-85 and $\geq$ 86 years ($p = 0.012$ and $p = 0.003$, respectively), emergency surgery ($p = 0.005$), recent respiratory failure ($p = 0.003$), intrathoracic surgery ($p = 0.009$), upper abdominal surgery ($p = 0.006$), and ketamine ($p = 0.002$) were significantly related to 24-hour perioperative cardiac arrest in geriatric patients as shown in Table 3.

Discussion

There has been increasing interest in studying the risks or predictors of anesthesia related mortality and morbidity, in order to improve quality of anesthesia care either in the general population or in a specific group of patients such as pediatric[13,14] or geriatric patients[15]. The anesthesia-related factors have been studied using different types of database such as local hospital records, incidents reports, closed claims, etc. The reported cases may be compulsory or voluntary. Voluntary reports inform reliable data but their limitations include under-reporting, selective report, and lack of the total number of anesthesia care performed.

The presented registry provides a large quantitative anesthesia database obtaining sufficient prospective data for the investigation of related factors of 24-hour perioperative cardiac arrest. The incidence of 24-hour perioperative cardiac arrest in our institute was 40.4:10,000 anesthetics, which was higher than the average incidence of 30.8:10,000 anesthetics in the THAI Study[12]. This was because our reports were confined to aging patients, which was similar to the incidence of other Thai university hospital[16]. However, the presented incidence was lower than the incidence of 68.8:10000 at a Brazilian teaching hospital[10]. Only the intraoperative mortality rate of geriatric patients was

Table 1. Demographic and baseline characteristics of geriatric patients with 24-hour perioperative cardiac arrest (univariate analysis)

Factors	24-hour perioperative cardiac arrest		Crude RR	95% CI	p-value
	Yes (n = 36) n (%)	No (n = 8,869) n (%)			
Gender					
Male	17 (47.2)	4,317 (48.7)	1.0		
Female	19 (52.8)	4,552 (51.3)	1.0	0.8-1.4	0.862
Age (years)					
65-75	14 (38.9)	6,107 (68.8)	1.0		
76-85	16 (44.4)	2,364 (26.7)	1.9	1.3-2.9	0.003
≥ 86	6 (16.7)	398 (4.5)	4.9	2.4-9.9	<0.001
BMI (kg/m^2)					
≤18.49	4 (11.1)	963 (10.9)	0.9	0.4-2.1	0.754
18.50-24.99	27 (75.0)	5,502 (62.0)	1.0		
25.00-29.99	4 (11.1)	1,933 (21.8)	0.8	0.4-1.4	0.295
≥ 30.00	1 (2.8)	9 (0.1)	0.5	0.1-2.8	0.847
History of smoking	3 (8.3)	664 (7.5)	1.1	0.4-3.3	0.847
Premedication					
Midazolam	2 (5.6)	701 (7.9)	0.7	0.2-2.6	0.602
Diazepam	1 (2.8)	41 (0.5)	6.0	1.1-34.1	0.043
Comorbidity					
Cardiovascular disease	26 (72.2)	5,083 (57.3)	1.3	1.0-1.6	0.071
Respiratory disease	5 (13.9)	599 (6.8)	2.1	0.9-4.7	0.089
Neuromuscular disease	8 (22.2)	755 (8.5)	2.6	1.4-5.0	0.003
Hematological disease	16 (44.2)	831 (9.4)	4.7	3.1-7.3	<0.001
Endocrine disease	12 (33.3)	2,335 (26.3)	1.3	0.8-2.1	0.341
Miscellaneous	13 (36.1)	935 (10.5)	3.4	2.1-5.6	<0.001
Respiratory disease					
COPD	2 (5.6)	222 (2.5)	2.2	0.6-8.5	0.243
Recent respiratory failure	3 (8.3)	22 (0.3)	33.6	15.8-71.3	<0.001
Cardiovascular disease					
Hypertension	19 (52.8)	4,298 (48.5)	1.1	0.8-1.5	0.605
Congestive heart failure	3 (8.3)	172 (1.9)	4.3	1.5-12.1	0.006
Ischemic heart disease	11 (30.6)	1,202 (13.6)	2.3	1.3-3.9	0.003
Shock / Impending shock	7 (19.4)	101 (1.1)	17.1	9.8-29.8	<0.001
Vascular disease	1 (2.8)	193 (2.2)	1.2	0.2-8.9	0.805
Arrhythmia	5 (13.9)	323 (3.6)	3.8	1.7-8.5	0.001
Valvular heart disease	1 (2.8)	297 (3.4)	0.8	0.1-5.7	0.849
Cardiovascular accident	2 (5.6)	467 (5.3)	1.1	0.3-4.1	0.938
Hematology disease					
Anemia	12 (33.3)	677 (7.6)	4.4	2.6-7.2	<0.001
Coagulopathy	4 (11.1)	144 (1.6)	6.8	2.9-16.0	<0.001
Endocrine disease					
D M	11 (30.6)	2,161 (24.4)	1.3	0.8-2.1	0.388
Electrolyte imbalance (Acid-Base imbalance)	4 (11.1)	139 (1.6)	7.1	3.0-16.5	<0.001
Neuromuscular disease					
Alteration of conscious	6 (16.7)	260 (2.9)	5.7	2.8-11.5	<0.001
CVA / TIA	2 (5.6)	467 (5.3)	1.1	0.3-4.1	0.938
Increased ICP	1 (2.8)	84 (1.0)	2.9	0.5-19.0	0.755
Miscellaneous					
Sepsis	7 (19.4)	169 (1.9)	10.2	5.6-18.7	<0.001
Renal disease	6 (16.7)	662 (7.5)	2.2	1.1-4.8	0.036
Liver disease	2 (5.6)	157 (1.8)	3.1	0.8-11.6	0.087

Table 1. (Cont.)

Factors	24-hour perioperative cardiac arrest		Crude RR	95% CI	p-value
	Yes (n = 36) n (%)	No (n = 8,869) n (%)			
ASA Physical status					
2	2 (5.6)	6,368 (71.8)	1.0		
3-5	34 (94.4)	2,501 (28.2)	3.4	2.6-4.4	<0.001
Surgical conditions					
Elective	15 (41.7)	7,680 (86.6)	1.0		
Emergency	21 (58.3)	1,189 (13.4)	4.4	3.0-6.3	<0.001
Site of surgery					
Intracranial surgery	2 (5.6)	384 (4.3)	1.3	0.3-5.0	0.719
Intrathoracic surgery	5 (13.9)	267 (3.0)	4.6	2.1-10.2	<0.001
Upper abdominal surgery	13 (36.1)	1,004 (11.3)	3.2	2.0-5.2	<0.001
Lower abdominal surgery	4 (11.1)	1,606 (18.1)	0.6	0.3-1.5	0.276
Extremities surgery	7 (19.4)	1,650 (18.6)	1.1	0.5-2.0	0.897
Cardiac surgery	1 (2.8)	433 (4.9)	0.6	0.1-3.8	0.558
Main anesthesia techniques					
Non GA (MAC, Spinal block, and Epidural block)	1 (2.8)	2,348 (26.5)	1.0		
General anesthesia (GA./TIVA)	35 (97.2)	6,521 (73.5)	1.3	1.1-1.6	0.002
Duration of anesthesia					
< 30 min	3 (8.3)	656 (7.4)	1.0		
30-59 min	2 (5.6)	1,023 (11.5)	0.7	0.3-1.6	0.338
1-3 hours	22 (61.1)	5,021 (56.6)	1.0	0.9-1.1	0.945
> 3 hours	9 (25)	2,169 (24.5)	1.0	0.7-1.3	0.884

Table 2. Anesthetic agents and 24-hour perioperative cardiac arrest in geriatric patients (univariate analysis)

Anesthetic agents	24-hour perioperative cardiac arrest		Crude RR	95% CI	p-value
	Yes (n = 36) n (%)	No (n = 8,869) n (%)			
Pentothal	7 (19.4)	3,156 (35.6)	0.5	0.3-1.0	0.043
Propofol	3 (8.33)	2,215 (25.0)	0.3	0.1-0.8	0.021
Ketamine	4 (11.1)	71 (0.8)	13.9	6.5-29.7	<0.001
Midazolam	15 (41.7)	1,212 (13.7)	3.0	1.9-4.8	<0.001
Succinylcholine	8 (22.2)	2,157 (24.3)	0.9	0.5-1.7	0.770
Pancuronium	14 (38.9)	1,695 (19.1)	2.0	1.3-3.2	0.003
Atracurium	4 (11.1)	1,933 (21.8)	0.5	0.2-1.2	0.121
Cistracurium	6 (16.7)	941 (10.6)	1.6	0.7-3.3	0.239
Vecuronium	4 (11.1)	639 (7.2)	1.5	0.6-3.9	0.366
Mivacurium	3 (8.3)	262 (2.9)	2.8	1.0-8.2	0.058
Rocuronium	3 (8.3)	177 (2.0)	4.2	1.5-11.8	0.007
Nitrous oxide	13 (36.1)	4,989 (56.3)	0.6	0.4-0.9	0.015
Isoflurane	16 (44.4)	4,352 (49.1)	0.9	0.6-1.3	0.580
Sevoflurane	7 (19.4)	1,734 (19.6)	1.0	0.5-1.9	0.987
Desflurane	3 (8.3)	426 (4.8)	1.7	0.6-5.2	0.324
Morphine	4 (11.1)	2,196 (24.8)	0.4	0.2-1.0	0.058
Fentanyl	17 (47.2)	4,201 (47.4)	1.0	0.7-1.4	0.986
Pethidine	2 (5.6)	472 (5.3)	1.0	0.3-4.0	0.950
Lidocaine	1 (2.8)	218 (2.5)	1.1	0.2-7.9	0.902
Prostigmine	1 (2.8)	2,015 (22.7)	0.1	0.03-0.52	0.004

Table 3. Factors related to 24-hour perioperative cardiac arrest in geriatric patients (multivariate analysis)

Factors	Adjusted RR	95% confident interval	p-value
Age (years)			
65-75	1.0		
76-85	2.6	1.2-5.4	0.012
≥ 86	4.4	1.7-11.8	0.003
ASA Physical status			
2	1.0		
3-5	19.9	4.6-86.0	<0.001
Emergency surgery	2.8	1.4-5.6	0.005
Intrathoracic surgery	3.7	1.4-9.9	0.009
Upper abdominal surgery	2.8	1.3-5.7	0.006
Recent respiratory failure	6.6	1.9-22.8	0.003
Ketamine	5.4	1.8-15.9	0.002

higher than that of overall population surgical patients in our recent previous study (62.5% vs. 48.0%)[17]. However, this mortality was lower than the average incidence of Thailand in the THAI Study of perioperative death[18]. This might be because the present study was confined to a tertiary care referral university hospital where anesthesia is provided by full-time academic faculty and residents.

It is rather difficult to compare the cardiac arrest and mortality rates among different reports because of different study designs, lack of uniformity of definition, time span, and organizational culture (blame or errors)[19]. In the present study, the mortality among elderly patients was high, which was similar to previous studies that advanced age increases the risk of perioperative mortality[17,20-24].

Gender is known to be a significant factor of perioperative cardiac arrest and mortality that males represent greater risk than females[10,11,14,17]. The possible reason in this difference are men trending to suffer from more severe cardiopulmonary diseases in the elderly or severe traumatic injuries in young adults whereas females receive a larger number of minor gynecologic surgery. However, in both univariate and multivariate analysis, gender and body mass index did not constitute higher risk because the present study was confined to only patients aged 65 years and over.

Age between 76 to 85 and ≥ 86 years posed 1.9 folds and 4.9 folds higher risk compared with 24-hour perioperative cardiac arrest in age groups between 65 to 75 years. This was corresponding to studies that anesthesia related cardiac arrest and death in 70-80 years old patients seemed to be increasing particularly during hip surgery[10,21,24,25]. The explanation may be that organ function is reduced with increasing age. Therefore, the present study confirmed that age in itself carried a risk for elderly surgical patients.

By multivariate analysis, ASA physical status 3-5 was the strongest predictor of 24-hour perioperative cardiac arrest with adjusted risk ratio of 19.9. The rate of perioperative cardiac arrest in ASA physical status 3-5 patients was 1.34% (38.2:10000 anesthetics) compared with 0.03% (2.3:10000 anesthetics) in ASA physical status 2 patients ($p < 0.001$). This confirmed the finding of previous reports[10,11,26,27], that ASA physical status may be a result of pre-existing disease such as cardio-pulmonary diseases and neurological diseases. The present study also revealed that cardiac arrest frequency was 6.6 folds higher in patients with recent pulmonary failure. Twenty-one patients out of 36 (58.3%) perioperative cardiac arrest were operated under emergency condition. Emergency surgery was also a statistically significant predictor of cardiac arrest with adjusted relative risks of 2.3. This was similar to several studies[10,11,14,17,23,26].

Upper abdominal surgery and intrathoracic surgery accounted for 36.1% and 13.9% of all 24-hour perioperative cardiac arrest respectively. These two sites of surgery were 2.8 and 3.7 folds higher risk of cardiac arrest. Djokovic and Hedley-Whyte reported that 57% of patients receiving intrathoracic surgery and 24% of patients underwent upper abdominal surgery required controlled ventilation[28]. Recently Kojima and Narita also revealed patients undergoing abdominal surgery associated with decreased survival rates[29]. Moreover, several studies stated that emergency abdominal surgery was associated with increased morbidity and mortality, especially in

old patients[30-33]. In contrast, the THAI Study of perioperative death in geriatric patients did not show that sites of operation were significant risk factors of death[11]. All but one geriatric patient who experienced cardiac arrest received general anesthesia. Several studies showed that cardiac arrest incidence is higher during general anesthesia[10,24,34,35]. This may be because high-risk surgeries are performed under general anesthesia. Moreover, there may be selection bias towards general anesthesia in emergency condition or in patients who have underlying diseases[36]. Likewise, the comprehensive recent surveys of intraoperative cardiac arrest after spinal anesthesia revealed incidence of 2.7:10000 neuraxial anesthesia[37,38]. The use of new local anesthetics with fewer side-effects, routinely used of pulse oximetry and improving knowledge of neuraxial block physiology has substantially decreased risk of major adverse events after neuraxial anesthesia. None of the cardiac arrest in the present series received neuraxial anesthesia. Ketamine was the only anesthetic shown to be a statistically significant risk of cardiac arrest. It was recommended in some situations because of its advantage of cardiovascular stimulation and preservation of breathing[39,40]. In contrast, ketamine can cause negative inotropic effect leading to hypotension and poor perfusion in debilitating patients[41]. In the present study, two out of four cardiac arrest patients who received ketamine had chronic obstructive pulmonary disease.

There were some limitations of this study. Firstly, despite the design of registry that provided large quantitative database, this was non-randomized, non-blinded study, with the possibility of some selection or observers bias. Second concern was the retrospective analysis of prospective collected database that may have missing data. Thirdly, the low frequency of some potential factors resulted in a loss power for analysis.

Conclusion

The incidence of intraoperative, within 24-hour postoperative, and overall 24-hour perioperative cardiac arrest were 18:10000 (mortality rate 62.5%; 10 out of 16), 22.5:10000 (mortality rate 90%; 18 out of 20), and 40.4:10000 (mortality rate 77.8%; 28 out of 36), respectively. Risk factors for 24-hour perioperative cardiac arrest were older age, ASA physical status 3-5, emergency surgery, intrathoracic surgery, upper abdominal surgery, recent respiratory failure, and administration of ketamine. Thoroughly preanesthetic evaluation is important for finding the risks and optimal preparation for preventing cardiac arrest.

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References

1. Institute of Population and Social Research, Mahidol University. Population of Thailand, 2008: Estimated population at midyear 2008 (1st July). Mahidol Population Gazeette 2008; 27: 1-2.
2. Ergina PL, Gold SL, Meakins JL. Perioperative care of the elderly patient. World J Surg 1993; 17: 192-8.
3. Liu LL, Leung JM. Predicting adverse postoperative outcomes in patients aged 80 years or older. J Am Geriatr Soc 2000; 48: 405-12.
4. Manku K, Bacchetti P, Leung JM. Prognostic significance of postoperative in-hospital complications in elderly patients. I. Long-term survival. Anesth Analg 2003; 96: 583-9.
5. Leung JM, Dzankic S. Relative importance of preoperative health status versus intraoperative factors in predicting postoperative adverse outcomes in geriatric surgical patients. J Am Geriatr Soc 2001; 49: 1080-5.
6. Williams SL, Jones PB, Pohalf WE. Preoperative management of the older patients-A surgeon's perspective: Part I. Clinical Geriatrics 2006; 14: 24-8.
7. Punjasawadwong Y, Chinachoti T, Charuluxananan S, Pulnitiporn A, Klanarong S, Chau-in W, et al. The Thai Anesthesia Incidents Study (THAI Study) of oxygen desaturation. J Med Assoc Thai 2005; 88 (Suppl 7): S41-53.
8. Collaborative overview of randomised trials of antiplatelet therapy-III: Reduction in venous thrombosis and pulmonary embolism by antiplatelet prophylaxis among surgical and medical patients. Antiplatelet Trialists' Collaboration. BMJ 1994; 308: 235-46.

9. Olsson GL, Hallen B, Hambraeus-Jonzon K. Aspiration during anaesthesia: a computer-aided study of 185,358 anaesthetics. Acta Anaesthesiol Scand 1986; 30: 84-92.
10. Braz LG, Modolo NS, do NP Jr, Bruschi BA, Castiglia YM, Ganem EM, et al. Perioperative cardiac arrest: a study of 53,718 anaesthetics over 9 yr from a Brazilian teaching hospital. Br J Anaesth 2006; 96: 569-75.
11. Rodanant O, Hintong T, Chua-in W, Tanudsintum S, Sirinanmd C, Kyokong O. The Thai anesthesia incidents study (THAI Study) of perioperative death in geriatric patients. J Med Assoc Thai 2007; 90: 1375-81.
12. Charuluxananan S, Punjasawadwong Y, Suraseranivongse S, Srisawasdi S, Kyokong O, Chinachoti T, et al. The Thai Anesthesia Incidents Study (THAI Study) of anesthetic outcomes: II. Anesthetic profiles and adverse events. J Med Assoc Thai 2005; 88 (Suppl 7): S14-29.
13. Cohen MM, Cameron CB, Duncan PG. Pediatric anesthesia morbidity and mortality in the perioperative period. Anesth Analg 1990; 70: 160-7.
14. Keenan RL, Boyan CP. Cardiac arrest due to anesthesia. A study of incidence and causes. JAMA 1985; 253: 2373-7.
15. Edwards AE, Seymour DG, McCarthy JM, Crumplin MK. A 5-year survival study of general surgical patients aged 65 years and over. Anaesthesia 1996; 51: 3-10.
16. Boonmak P, Boonmak S, Sathitkarnmanee T, Chau-in W, Nonlhaopol D, Thananun M. Surveillance of anesthetic related complications at Srinagarind Hospital, Khon Kaen University, Thailand. J Med Assoc Thai 2005; 88: 613-22.
17. Kyokong O, Charuluxanannan S, Werawatganon T, Termsombatborworn N, Leelachiechankul F. Risk factors of perioperative death at a university hospital in Thailand: a registry of 50,409 anesthetics. Asian Biomed 2008; 2: 51-8.
18. Charuluxananan S, Chinachoti T, Pulnitiporn A, Klanarong S, Rodanant O, Tanudsintum S. The Thai Anesthesia Incidents Study (THAI Study) of perioperative death: analysis of risk factors. J Med Assoc Thai 2005; 88 (Suppl 7): S30-40.
19. Derrington MC, Smith G. A review of studies of anaesthetic risk, morbidity and mortality. Br J Anaesth 1987; 59: 815-33.
20. Tiret L, Desmonts JM, Hatton F, Vourc'h G. Complications associated with anaesthesia - a prospective survey in France. Can Anaesth Soc J 1986; 33: 336-44.
21. Biboulet P, Aubas P, Dubourdieu J, Rubenovitch J, Capdevila X, d'Athis F. Fatal and non fatal cardiac arrests related to anesthesia. Can J Anaesth 2001; 48: 326-32.
22. Kawashima Y, Takahashi S, Suzuki M, Morita K, Irita K, Iwao Y, et al. Anesthesia-related mortality and morbidity over a 5-year period in 2,363,038 patients in Japan. Acta Anaesthesiol Scand 2003; 47: 809-17.
23. Newland MC, Ellis SJ, Lydiatt CA, Peters KR, Tinker JH, Romberger DJ, et al. Anesthetic-related cardiac arrest and its mortality: a report covering 72,959 anesthetics over 10 years from a US teaching hospital. Anesthesiology 2002; 97: 108-15.
24. Sprung J, Warner ME, Contreras MG, Schroeder DR, Beighley CM, Wilson GA, et al. Predictors of survival following cardiac arrest in patients undergoing noncardiac surgery: a study of 518,294 patients at a tertiary referral center. Anesthesiology 2003; 99: 259-69.
25. Tikkanen J, Hovi-Viander M. Death associated with anaesthesia and surgery in Finland in 1986 compared to 1975. Acta Anaesthesiol Scand 1995; 39: 262-7.
26. Morray JP, Geiduschek JM, Ramamoorthy C, Haberkern CM, Hackel A, Caplan RA, et al. Anesthesia-related cardiac arrest in children: initial findings of the Pediatric Perioperative Cardiac Arrest (POCA) Registry. Anesthesiology 2000; 93: 6-14.
27. Latkauskas T, Rudinskaite G, Kurtinaitis J, Janciauskiene R, Tamelis A, Saladzinskas Z, et al. The impact of age on post-operative outcomes of colorectal cancer patients undergoing surgical treatment. BMC Cancer [serial on the Internet] 2005 Dec [cited 2008 Oct 26];5:153. Available from: http://www.biomedcentral.com/content/pdf/1471-2407-5-153.pdf
28. Djokovic JL, Hedley-Whyte J. Prediction of outcome of surgery and anesthesia in patients over 80. JAMA 1979; 242: 2301-6.
29. Kojima Y, Narita M. Postoperative outcome among elderly patients after general anesthesia. Acta Anaesthesiol Scand 2006; 50: 19-25.
30. Linn BS, Linn MW, Wallen N. Evaluation of results of surgical procedures in the elderly. Ann Surg 1982; 195: 90-6.
31. Walsh TH. Audit of outcome of major surgery in the elderly. Br J Surg 1996; 83: 92-7.
32. Kettunen J, Paajanen H, Kostiainen S. Emergency

abdominal surgery in the elderly. Hepatogastroenterology 1995; 42: 106-8.
33. Warden JC, Borton CL, Horan BF. Mortality associated with anaesthesia in New South Wales, 1984-1990. Med J Aust 1994; 161: 585-93.
34. Ruiz Neto PP, Gomide do Amaral RV. Cardiac arrest during anesthesia in a multicenter hospital: a descriptive study. Rev Bras Anestesiol 1986; 36: 149-58.
35. Gaba DM. Anaesthesiology as a model for patient safety in health care. BMJ 2000; 320: 785-8.
36. Morray JP, Bhananker SM. Recent findings from the pediatric perioperative cardiac arrest (POCA) registry. ASA Newsl 2005; 69: 10-2.
37. Auroy Y, Narchi P, Messiah A, Litt L, Rouvier B, Samii K. Serious complications related to regional anesthesia: results of a prospective survey in France. Anesthesiology 1997; 87: 479-86.
38. Charuluxananan S, Thienthong S, Rungreungvanich M, Chanchayanon T, Chinachoti T, Kyokong O, et al. Cardiac arrest after spinal anesthesia in Thailand: a prospective multicenter registry of 40,271 anesthetics. Anesth Analg 2008; 107: 1735-41.
39. White PF, Way WL, Trevor AJ. Ketamine - its pharmacology and therapeutic uses. Anesthesiology 1982; 56: 119-36.
40. Pesonen P. Pulse oximetry during ketamine anaesthesia in war conditions. Can J Anaesth 1991; 38: 592-4.
41. Pagel PS, Kampine JP, Schmeling WT, Warltier DC. Ketamine depresses myocardial contractility as evaluated by the preload recruitable stroke work relationship in chronically instrumented dogs with autonomic nervous system blockade. Anesthesiology 1992; 76: 564-72.

ปัจจัยที่เกี่ยวข้องกับการเกิดภาวะหัวใจหยุดเต้นของผู้ป่วยสูงอายุในระหว่างการให้ยาระงับความรู้สึกในโรงพยาบาลมหาวิทยาลัยของประเทศไทย

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ภูมิหลัง: *โรงพยาบาลจุฬาลงกรณ์เป็นหนึ่งในโรงพยาบาลที่เข้าร่วมโครงการศึกษาอุบัติการณ์เกิดภาวะแทรกซ้อนทางวิสัญญีในประเทศไทย (THAI Study) ภาควิชาวิสัญญีวิทยา คณะแพทยศาสตร์จุฬาลงกรณ์มหาวิทยาลัย ได้ดำเนินการเก็บข้อมูลอย่างต่อเนื่อง เพื่อศึกษาอุบัติการณ์และปัจจัยที่เกี่ยวข้องกับการเกิดภาวะหัวใจหยุดเต้นของผู้ป่วยสูงอายุ (อายุ 65 ปีขึ้นไป) ในช่วง 24 ชั่วโมงระหว่างการให้ยาระงับความรู้สึก*

วัสดุและวิธีการ: *ระหว่างวันที่ 1 กรกฎาคม พ.ศ. 2546 – วันที่ 31 มีนาคม พ.ศ. 2550 มีการเก็บข้อมูลแบบทะเบียนโรคของการให้ยาระงับความรู้สึกสำหรับการผ่าตัดในโรงพยาบาลจุฬาลงกรณ์ วิสัญญีแพทย์และแพทย์ประจำบ้านวิสัญญีทำการบันทึกข้อมูลเกี่ยวกับลักษณะผู้ป่วยด้านศัลยกรรม ข้อมูลด้านวิสัญญี และภาวะแทรกซ้อนต่าง ๆ ที่เกิดขึ้น รวมทั้งภาวะหัวใจหยุดเต้นในช่วงก่อนให้ยาระงับความรู้สึก ระหว่าง และหลังผ่าตัดจนถึง 24 ชั่วโมง ลงในแบบบันทึกข้อมูลเชิงโครงสร้าง ทำการวิเคราะห์ข้อมูลแบบ univariate และ multivariate เพื่อหาปัจจัยที่เกี่ยวข้องกับการเกิดอุบัติการณ์ โดย ค่า $p < 0.05$ ถือว่ามีนัยสำคัญทางสถิติ*

ผลการศึกษา: *จากจำนวนผู้รับบริการทางวิสัญญีทั้งหมด 54,419 ราย เป็นผู้ป่วยอายุตั้งแต่ 65 ปีขึ้นไปเข้ารับการผ่าตัดที่ไม่ใช่การผ่าตัดหัวใจ จำนวนทั้งหมด 8,905 ราย มีผู้ป่วยที่เกิดภาวะหัวใจหยุดเต้นจำนวน 36 ราย มีอุบัติการณ์เท่ากับ 40.4:10000 ของการให้ยาระงับความรู้สึก โดยพบว่ามีปัจจัยที่เกี่ยวข้องกับการเกิดภาวะหัวใจหยุดเต้นระหว่างการให้ยาระงับความรู้สึก ได้แก่ อายุ 76-85 ปี [RR 2.6 (95% CI: 1.2, 5.4)], อายุตั้งแต่ 86 ปีขึ้นไป [RR 4.4 (95% CI: 1.7, 11.8)], ASA physical status 3-5 [RR 19.9 (95% CI: 4.6, 86)] มีภาวะหัวใจล้มเหลวก่อนผ่าตัด [RR 6.6 (95% CI: 1.9, 22.3)], การผ่าตัดฉุกเฉิน [RR 2.8 (95% CI: 1.4, 5.6)], การผ่าตัดบริเวณทรวงอก [RR 3.7 (95% CI: 1.4, 9.9)], การผ่าตัดช่องท้องส่วนบน [RR 2.8 (95% CI: 1.3, 5.7)], และได้รับยา ketamine [RR 5.4 (95% CI: 1.8, 15.9)]*

สรุป: *อุบัติการณ์ของการเกิดภาวะหัวใจหยุดเต้นภายหลังการได้รับยาระงับความรู้สึกภายใน 24 ชั่วโมงของผู้ป่วยสูงอายุในการศึกษานี้เท่ากับ 40.4:10000 ของการให้ยาระงับความรู้สึก ซึ่งไม่แตกต่างจากการศึกษาอื่น ๆ แต่มีอัตราการเสียชีวิตสูงกว่า ปัจจัยเสี่ยงต่อการเกิดภาวะหัวใจหยุดเต้นระหว่างการให้ยาระงับความรู้สึกในผู้ป่วยสูงอายุได้แก่ อายุที่มากขึ้น, ASA physical status 3-5, การผ่าตัดฉุกเฉิน, การผ่าตัดบริเวณทรวงอก, การผ่าตัดในช่องท้องส่วนบน, มีภาวะระบบหายใจล้มเหลวก่อนผ่าตัด, และการได้รับยา ketamine*