The Thai Anesthesia Incidents Study (THAI Study) of Perioperative Death in Geriatric Patients

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Background: *The study was part of the Thai Anesthesia Incidents Study (THAI Study), a multi-centered study conducted by the Royal College of Anesthesiologists of Thailand, aiming to survey anesthetic related complications in Thailand.*
Objective: *Identify the incidence and factors related to perioperative death in geriatric patients.*
Material and Method: *During a 12 months period (March 1, 2003 – February 28, 2004), a prospective multicenter descriptive study conducted in 20 hospitals comprising of seven university, five tertiary, four general and four district hospitals across Thailand. Anesthesia personnel filled up patient-related data, surgical-related, and anesthesia related variables and adverse outcomes of geriatric patients (age $\geq$ 65 yr) on a structured data entry form. The data were collected during pre-anesthetic, intra-operative, and 24 hr post operative periods.*
Results: *The overall mortality was 39.3 per 10,000 anesthetics from the registry of 23,899 geriatric patients receiving anesthesia. Multiple regression analysis showed that higher American Society of Anesthesiologists (ASA) physical status grading ($p < 0.001$), emergency operation ($p = 0.031$) and current medications ($p = 0.043$) were factors related to 24 hr perioperative death in geriatric patients. Patient's underlying diseases and duration of operations were not significantly related to death.*
Conclusion: *The present study showed an incidence of 24-hr perioperative death of 1: 254 in geriatric patients receiving anesthesia, which is comparable to other countries. Mortality in elderly patients operated under anesthesia can be predicted by ASA physical status, current medications, and emergency condition.*

Keywords: *Anesthesia, incidence, Geriatric, Perioperative death, Mortality rate, Complication*

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As the population ages and requires more health care, a significant part of this, is in surgical services. Elderly patients account for a growing proportion of most surgeons' practices. Therefore, it is apparent that this patient group has special requirements, differences in outcomes, and different physiology from other patients encountered in the typical surgical practices. More and more elderly patients are being encouraged to have surgery on the basis of advances in surgical and anesthetic management. However, pre-operative decision-making for elderly patients requires a longer-term perspective because, even if the procedure is successful, surgery and subsequent hospitalization are often followed by an irreversible decline in functional status[1], leading to a shorter life expectancy. Despite these advances, surgery in the elderly remains riskier than in younger age groups.

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Medicare data indicate that there is increasing mortality associated with increasing age for major vascular and cancer surgery[2]. However, there is a debate as to whether it is age or coexisting disease that is responsible for this mortality.

Perioperative death in geriatrics is one of the most serious and important complications. However, the data for anesthetic mortality of geriatric patients in Thailand are scarce. Therefore, the Royal College of Anesthesiologists of Thailand hosted the Thai Anesthesia Incidents Study (THAI Study) of anesthetic adverse outcomes for study of incidences and risk factors of anesthesia related complications[3,4]. The aim of this study, as part of THAI Study, was to identify the risk factors that contribute to perioperative death in geriatric patients within a 24-hr post operative.

Material and Method

The Thai Anesthesia Incidents Study (THAI Study) of anesthetic adverse outcomes was a prospective, multi-centered registry of consecutive anesthetic performed in 20 hospitals (7 university hospitals: Chiang Mai University, Chulalongkorn University, Siriraj Hospital and Ramathibodi Hospital, Pramonkutklao Medical College, Prince of Songkla University), 5 tertiary hospitals (Buddhachinaraj Hospital, Ratchaburi Hospital, Nakorn Sri Thammarat, Khon Kaen Hospital and Prasat Neurological Institute), 4 general hospitals (Lampoon Hospital, Pichit Hospital, Baan Pong Hospital and Trang Hospital) and 4 district hospitals (Sanpatong Hospital, Nakorn-Thai Hospital, Kranuan Hospital and Nampong Hospital) from all regions of Thailand. Thai study was approved by all institutional ethical review boards without additional written informed consent needed.

During the period from 1st March 2003 to 28th February 2004, 172,697 anesthetics had been carried out in 20 hospitals. Of these, 23,899 patients, aged 65 years and over, were operated under anesthesia. The attending anesthesia personnel or site managers were requested to fill the data-entry form. Whenever perioperative death (intra-operative to 24-hr post operative period) in geriatric patients occurred, the details of events were recorded in a data entry form specific to the death. For the purpose of analysis, timing of events was divided into three periods: intra-operative, recovery room, and 24-hr post operative periods. All forms were reviewed and these data were further analyzed to identify contributing factors.

Descriptive statistics was used for analysis of the data. Chi-square test or Fisher's exact test were used to compare categorical data, T-test was used to analyze continuous data. Multiple logistic regression was used to test for exclusion on the basis of the probability of a log likelihood test ratio. The analysis ended when no further variables for inclusion or exclusion

Table 1. Demographic and baseline characteristics of geriatric patients with perioperative death (n = 94)

Gender:	
Male	51 (54.3%)
Female	43 (45.7%)
Age(yr) range	
65-75	59 (62.7%)
76-85	30 (31.9%)
≥ 86	5 (5.3%)
Weight (kg)	55.95 ± 1.53
Height (cm)	158.38 ± 0.936
BMI	22.20 ± 0.54
Duration of anesthesia	
< 1 hr	24 (25.5%)
1-3 hr	57 (60.6%)
> 3 hr	13 (13.8%)
Timing of event	
Intraoperative	17 (18.09%)
Recovery room	0
24 hr postoperative	77 (81.91%)
ASA physical status	
I	0
II	12 (12.8%)
III	25 (26.6%)
IV	36 (38.3%)
V	21 (22.3%)
Surgical condition	
Elective	42 (44.7%)
Emergency	52 (55.3%)
Site of operation	
Head & neck	7 (7.45%)
Intracranial	8 (8.51%)
Intrathoracic	5 (5.32%)
Intraabdominal	40 (42.55%)
Extremities	15 (15.96%)
Scope	3 (3.19%)
X-rays	3 (3.19%)
Others	13 (13.83%)
Main anesthetic technique	
GA	70 (74.5%)
GA (TIVA)	3 (3.2%)
MAC	13 (13.8%)
Spinal anesthesia	8 (8.5%)

Value are shown as Mean (SD), number (%)
GA = General anesthesia, TIVA = Total intravenous anesthesia, MAC = monitor anesthesia care ASA PS = American Society of Anesthesiologists classification of physical status

were available with P value <0.05 considered as statistically significant. Odds ratio (OR) and 95% confidence interval were analysis.

Result

In the present study, there were 23,899 geriatric patients receiving anesthesia during a 12 months period; 94 (0.4%) of them died perioperatively within a 24-hr post operative period. There were 51 (54.3%) males and 43 (45.7%) females. The most common age range that death occurred was between 65-75 years old (62.7%). The average body mass index (BMI) was 22.20 $\pm$ 0.54. The demographic, surgical, and anesthetic characteristics are presented in Table 1.

Among 94 fatal cases, 77 patients (81.9%) died in the 24-hr post operative period and 17 patients (18.09%) died intra-operatively. Three-fourths of the deaths had operative duration longer than 1 hr. Univariate analysis of surgical and anesthesia variable are shown in Table 2. The results revealed that underlying respiratory disease ($p < 0.001$), cardiovascular disease ($p < 0.011$), neuromuscular disease ($p < 0.001$), hematological disease ($p < 0.001$), overall current medications ($p = 0.05$), ASA physical ($p < 0.001$), emergency condition ($p < 0.001$), no pre-anesthetic evaluation ($p < 0.001$) and anesthetic technique were statistically significant factors in univariate analysis. From multivariate logistic regression analysis, the authors only found that ASA PS ($p < 0.001$), emergency operation ($p < 0.031$) and current medications ($p < 0.043$) were significantly related statistically to perioperative death in geriatric patients as shown in Table 3.

Table 2. Association show relationship of the underlying diseases and current medical status with perioperative geriatric death

Factors	Survived, n = 23,805	Death within 24hr, n = 94	p-value
Respiratory disease	21,242 (89.2%)	68 (72.3%)	<0.001
Cardiovascular disease	12,997 (54.6%)	39 (41.5%)	0.011
Neuro-muscular disease	21,614 (90.8%)	70 (74.5%)	<0.001
Hematological disease	20,383 (85.6%)	60 (63.8%)	<0.001
Endocrine disease	18,363 (77.1%)	68 (72.3%)	0.2639
Current medication*	18,803 (79%)	82 (87.2%)	0.050
Gender:			0.838
Female	11,129 (46.8%)	43 (45.7%)	
Male	12,652 (53.2%)	51 (54.3%)	
ASA PS	n = 23,214	n = 94	<0.001
II	15,747 (67.8%)	12 (12.8%)	
III	6,363 (27.4%)	25 (26.6%)	
IV	1,061 (4.5%)	36 (38.3%)	
V	43 (0.2%)	21 (22.3%)	
Surgical condition	n = 23,489	n = 94	<0.001
Elective	18,587 (79.1%)	42 (44.7%)	
Emergency	4,902 (20.9%)	52 (55.3%)	
Preoperative evaluation	n = 23,514	n = 94	<0.001
Yes	10,924 (46.5%)	21 (22.3%)	
No	12,590 (53.5%)	73 (77.7%)	
Anesthetic technique	n = 22,708		<0.001
GA	13,134 (57.8%)	70 (74.5%)	
GA (TIVA)	1,273 (5.6%)	3 (3.2%)	
MAC	1,601 (7.0%)	13 (13.8%)	
Spinal	6,700 (29.5%)	8 (8.5%)	

Value are shown as number (%), Significant at $p < 0.05$

GA = General anesthesia, TIVA = Total intravenous anesthesia, MAC = Monitor anesthesia care

* Routine medications that previously administered such as antihypertensive drugs, oral hypoglycemics or insulin injection, etc

Table 3. Multivariate analysis of factors associated with 24 hr perioperative death in geriatric patient

	OR (95% confidence interval)	p-value
ASA PS	7.780 (5.99-10.103)	<0.001
Emergency	1.631 (1.046-2.543)	0.031
Current medication*	0.528 (0.284-0.980)	0.043

Significant at $p < 0.05$

ASA PS = American Society of Anesthesiologists classification of physical status

* Routine medications that previously administered such as antihypertensive drugs, oral hypoglycemics or insulin injection, etc

Discussion

Advanced age increases surgical and anesthetic morbidity and mortality due to decreasing organ function and reserve, change of pharmacokinetics and pharmacodynamics, presentation of primary surgical diseases and increasing incidence of comorbid diseases. Most geriatric patients had more than one system or one organ dysfunction before operation. Advances in surgical and anesthetic techniques and an aging patient population have resulted in more complex procedures being performed in greater numbers of aged subjects.

The total number of reported death in geriatric patients was 94 with an estimated incidence of 24-hr perioperative death per 10,000 anesthetic of 39.3 (or 1:254), but the absolute association with anesthesia or surgery could not be concluded. Overall incidence of death from all age groups was 28.3 per 10,000 anesthetics from our previous Thai study database[5]. In a recent study[6] of mortality associated with abdominal surgery in elderly patients, it was found that mortality was 22%. The overall mortality within 30 days of operation in the general population was 1.2%, compared with 2.2% in patients aged 60-69 years, between 70-79 years is 2.9%, older than 80 years of age is 5.8-6.2% and older than 90 years old is 8.4%. Some studies[7] reported the death rate in elderly age over 70 years old for elective surgical procedures ranging from 0% to 5.4%. However, the present results may be biased by study methods (voluntary reporting, closed claims analysis, classification of small subset) or post operative observation period.

Co-existing disease further depresses organ function and reserve, exacerbating risk[8]. For example; pre-existing hypertension, diabetes mellitus, or renal failure contribute to a higher incidence of perioperative myocardial infarction(5.1%), cardiac death (5.7%), or ischemia (12-17.7%). From the present study, the authors found that most of the dead patients (94.5%) had at least one underlying disease or combination of these systems insufficiency such as respiratory (72.3%), cardiovascular (41.5%), neuromuscular (74.5%), and hematology diseases (63.8%). However, these factors were statistically significantly related to death in univariate but not in multivariate analysis. The possible explanation is separated, underlying systemic diseases. Most medical conditions interact with the effect of aging to increase risk synergistically[9]. Moreover, all of these patients required medications for treatment of their underlying diseases which were significantly related to perioperative death ($p < 0.043$). Therefore, it may be implied that fatal outcome occurred in the geriatric cases with underlying diseases receiving medication. The same results had been shown by Braz LG et al[10] that perioperative mortality was relatively higher in neonates, infants, the elderly, and in males with severe underlying disease and under emergency surgery. All anesthesia-related cardiac arrests were related to airway management and medication administration, which is important for prevention strategies.

Emergency operations are a source of significant morbidity and mortality in older patients. These operations are required more frequently in older patients; several series reported that more than 15% of all operations performed in elderly patients are emergency procedures, a frequency that increases with advanced age[11]. The most common indications for emergency operations are infection, intestinal obstruction, incarcerated hernia, and hemorrhage. Additional risk factors in the elderly include not only the need for emergency surgery[12] but also major surgical procedures, ASA physical status III or IV, and poor nutritional status. The present study also demonstrated that an emergency operation was one of the risk factor in perioperative geriatric death ($p < 0.031$) as in previous reports that emergency surgery resulted in lower survival rates because of higher perioperative mortality rates[13,14] related to the advanced disease stage and poor physical condition, such as tissue hypoperfusion, acidosis and bleeding, at presentation. From the present report, more than 80% of the dead cases did not have the proper preoperative evaluation due to an emergency situation. Even though, the authors could not demonstrate the statistical significant related to death of inadequate pre-operative evaluation from the study, the authors still believe that at a minimum, the patient will require a pre-operative visit with

both the surgical and the anesthesiological services. Risk stratification and functional assessments will help to guide these practitioners in deciding how to improve the patient's medical condition prior to surgery.

General anesthesia alone was employed in most cases (74.5%); regional technique and monitored anesthesia care were conducted in 13.8% and 8.5% respectively. ASA physical status classification has been reported to be a useful predictor of perioperative death[15] and long-term survival[16]. Furthermore, in the present study, ASA physical status classification of perioperative geriatric death patients was significantly different statistically ($p < 0.001$). In the older patient, abdominal pathology more often present acutely, and mortality is greater than that of the younger patient[17]. Patients over age 65 years account for up to 50% of all emergency operations[18]. In one study, the authors found that 86% of perioperative deaths reported to a national database were in patients over age 60, and 57% of these reported death were after urgent or emergency operation[19].

Of ninety-four cases of perioperative geriatric death, the three most common services of these patients were general surgery, orthopedics, and neurosurgery. The three most common sites of operations were intra-abdominal, the extremities and intracranial respectively. Surgery of the trachea and neck were also considered risky. Even though the authors could not demonstrate the significant relationship between perioperative death and the site of operations, from a previous study[20] in Japan, the author could identify the three factors that were significantly associated with decreased survival rates. These were males, dependency in daily living, and intra-abdominal surgery.

Aging results in physiological changes that cause unique challenges to clinicians in the perioperative period. Pre-operative evaluation of the patient should emphasize functional evaluation, risk assessment, and optimization of medical conditions. During surgery, anesthetic and analgesic techniques are focused on decreasing the impact of physiological stress. Post operative complications such as pneumonia and congestive heart failure are more common in the elderly and must be anticipated. A comprehensive and multidisciplinary approach to caring for the elderly during the perioperative period can improve the outcome and decrease the risk for these patients.

In summary, from the present study revealed the incidence of perioperative death in geriatric patients was approximately 39.3 per 10,000 anesthetics. ASA physical status, patient's current medications, and emergency procedures are the significant factors related to perioperative death, which is consistent with earlier reports on perioperative mortality rates in geriatric patients using the same definition and similar mandatory reporting.

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การเสียชีวิตของผู้ป่วยสูงอายุในระหว่างการให้ยาระงับความรู้สึกจากการศึกษาอุบัติการณ์เกิดภาวะแทรกซ้อนทางวิสัญญีในประเทศไทย

อรลักษณ์ รอดอนันต์, ธนู หินทอง, วราภรณ์ เชื้ออินทร์, สุรศักดิ์ ถนัดศีลธรรม, โฉมชบา สิรินันทน์, อรนุช เกี่ยวข้อง

ภูมิหลัง: *การศึกษานี้เป็นส่วนหนึ่งของโครงการเฝ้าระวังภาวะแทรกซ้อนทางวิสัญญีในประเทศไทย (THAI Study)*
วัตถุประสงค์: *เพื่อศึกษาอุบัติการณ์และปัจจัยเกี่ยวข้องกับการเสียชีวิตในผู้ป่วยสูงอายุที่เข้ารับการผ่าตัดและได้ยาระงับความรู้สึก*
วัสดุและวิธีการ: *ทำการศึกษาแบบพรรณนาชนิดไปข้างหน้าในโรงพยาบาล 20 แห่งในภูมิภาคต่าง ๆ ของประเทศไทย (โรงพยาบาลมหาวิทยาลัย 7 แห่ง, โรงพยาบาลตติยภูมิ 5 แห่ง, โรงพยาบาลทั่วไป 4 แห่ง และโรงพยาบาลชุมชน 4 แห่ง) ในช่วงเวลา 12 เดือน (1 มีนาคม พ.ศ. 2546 – 28 กุมภาพันธ์ พ.ศ. 2547) โดยบุคลากรวิสัญญีเป็นผู้กรอกข้อมูลช่วงก่อนให้ยาระงับความรู้สึก ระหว่าง และหลังผ่าตัดจนถึง 24 ชั่วโมงในแบบฟอร์มข้อมูลเชิงโครงสร้าง ซึ่งมีข้อมูลเกี่ยวกับผู้ป่วยด้านศัลยกรรมและข้อมูลด้านวิสัญญี*
ผลการศึกษา: *จากการศึกษาแบบทะเบียนโรคในผู้ป่วยสูงอายุ(อายุ ≥ 65 ปี) ที่เสียชีวิต พบอุบัติการณ์การเสียชีวิตเป็น 39.3 ต่อการให้การระงับความรู้สึก 10,000 ราย จากผู้ป่วยสูงอายุที่ได้รับการระงับความรู้สึกทั้งหมด 23,899 ราย เมื่อนำข้อมูลมาวิเคราะห์เชิงถดถอยทางสถิติพบว่า สภาวะของผู้ป่วยที่จำแนกตามคำจำกัดความของสมาคมวิสัญญีแพทย์แห่งสหรัฐอเมริการะดับที่สูงขึ้น ($p < 0.001$), การผ่าตัดฉุกเฉิน ($p = 0.031$), และการที่ผู้ป่วยมีการใช้ยาประจำก่อนการได้รับการระงับความรู้สึก ($p = 0.043$) เป็นปัจจัยที่เกี่ยวเนื่องกับการเสียชีวิตของผู้ป่วยสูงอายุที่ได้รับการให้การระงับความรู้สึกอย่างมีนัยสำคัญ โดยชนิดโรคประจำตัวแต่ละกลุ่มโรคและระยะเวลาในการผ่าตัดไม่พบความสัมพันธ์กับการเสียชีวิตอย่างมีนัยสำคัญ*
สรุป: *อุบัติการณ์ผู้ป่วยสูงอายุเสียชีวิตภายหลังการได้รับยาระงับความรู้สึกภายใน 24 ชั่วโมงที่ได้จากการศึกษานี้เท่ากับ 1 ต่อ 254 ซึ่งอยู่ในอัตราที่ไม่ต่างจากประเทศอื่น สภาวะของผู้ป่วยที่จำแนกตามคำจำกัดความของสมาคมวิสัญญีแพทย์แห่งสหรัฐอเมริกา, การผ่าตัดฉุกเฉิน, และการที่ผู้ป่วยมีการใช้ยาประจำก่อนการได้รับการระงับความรู้สึกสามารถใช้เป็นตัวคาดเดาอุบัติการณ์ของการเสียชีวิตในผู้ป่วยสูงอายุที่ได้รับการให้ยาระงับความรู้สึกได้*