The Thai Anesthesia Incidents (THAI Study) of Anesthetic Risk Factors related to Perioperative Death and Perioperative Cardiovascular Complications in Intracranial Surgery

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Objective: *To evaluate the correlations between anesthetic risk factors and perioperative cardiovascular complications as well as perioperative death within 72 hours.*
Material and Method: *This case controlled took the data from the Thai Anesthesia Incidents Study (THAI Study), a prospective multi-centered registry of anesthesia in Thailand. The authors included all the patients who received intracranial surgery from 20 hospitals throughout Thailand. The present study was divided into two groups and focused on anesthetic factors that possibly related to perioperative cardiovascular complications or perioperative death. The statistical analysis were Chi Square test and logistic regression model with the statistical significance if p-value < 0.05 demonstrated in Odds ratio (OR) and 95% confidence interval.*
Results: *From the 7,430 patients, there were 63 patients (0.85%) with perioperative cardiovascular complication. The American Society of Anesthesiologists (ASA) physical status 3-5 (OR 5.77, 95%CI 2.33-14.27) and the absence of anesthesiologists (OR 2.19, 95%CI 1.06-4.54) had statistical correlation with the cardiovascular complication. Eighty-four patients (1.13%) who died within 72 hours post operatively were found. The ASA physical status 3-5 (OR 10.14, 95%CI 3.42-30.02), the emergency circumstance (OR 3.55, 95%CI 1.31-9.60), and the absence of endtidal carbondioxide monitor (OR 2.27, 95%CI 1.26-4.09) had statistical correlation with the perioperative death.*
Conclusion: *Predictors of perioperative cardiovascular complications in intracranial surgical patients were ASA physical status 3-5 and absence of certified board anesthesiologists. Risk factors of perioperative death were ASA physical status 3-5, emergency condition, and absence or no monitoring of capnometer.*

Keywords: *Anesthesia, Risk factor, Cardiovascular complication,Perioperative death, Intracranial surgery, Certified board anesthesiologist*

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The disease prognosis, quality of life, and survival rate are all influenced by perioperative complications. In 2005, a multi-centered study with a title of the Thai Anesthesia Incidents Study (THAI Study) of anesthetic adverse outcomes[1,2] was accomplished by Thai anesthesiologists. The perioperative cardiovascular complications (e.g. myocardial ischemia and

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myocardial infarction) were found in 2.7/10000. Neurovascular complications (e.g. coma, cerebrovascular accident, seizure) were found in 4.8/10000, respiratory complications (e.g. hypoxia) were found in 31.9/10000. Dead within 24 hours postoperatively was found in 28.3/10000. The incidences of each complication occurred frequently and were severe[1]. The preventive strategy can be developed from anesthetic risk analysis, especially on those jeopardy patients, the neurosurgical patients.

The perioperative risk factors are generally concerned by surgical risk factors, for example, postoperatively rebleeding[3], intracerebral hemorrhage, pre-operative vasospasm[3-5], and the duration and strengthening of intra-operative brain retraction[6]. The correlation analysis between anesthetic techniques, monitoring, special technique in anesthesia, medications including anesthetic factors, and perioperative complications have been less published even though those patients were taken care of by the majority of anesthesiologists and nurse anesthetists. Therefore, the authors performed this case controlled study to evaluate the correlations between anesthetic risk factors and perioperative cardiovascular complications, and perioperative death for further improvement of anesthesia service.

Material and Method

This case controlled study took the data from the THAI Study under the process of quality assurance from February 1, 2003 to August 31, 2004. The authors included all the patients who received intracranial surgery from 20 hospitals throughout Thailand, seven university hospitals, five regional hospitals, four provincial hospitals, and four community hospitals. The authors focused on anesthetic factors that were possibly related to perioperative cardiovascular complications or perioperative death like age, sex, American Society of Anesthesiologist (ASA) physical status, emergency situation, anesthetic durations, preoperative respiratory conditions, preoperative cardiovascular conditions, pre-operative neurological conditions, preoperative hematological conditions, preoperative endocrine conditions, premedications, the presence of anesthesiologist in anesthetic team, the usage of steroid drugs preoperatively, invasive monitoring (arterial blood pressure, central venous pressure and pulmonary wedge pressure monitoring), endtidal carbondioxide monitoring, special anesthetic techniques (hypotensive and hypothermic technique), induction agents, muscle relaxant, opioids, and inhalation agents. The study design was achieved as follows.

1. To determine factors associated with the perioperative cardiovascular complication, the authors separated intracranial surgical patients into two groups by simple randomization with SPSS software version 11.5. The control group was composed of 189 patients who did not have perioperative cardiovascular complications. The other group (the study group) was composed of 63 patients with perioperative cardiovascular complications. The number of patients in the study group should not be less than 23. The sample size was calculated from the study of Akavipat P, et al[7] who found that the ASA physical status 3-5 patients have a powerful correlation with post intracranial aneurysmal surgery complications and the incidence studied by Charuluxananan S et al[2] ($p_1 = 0.89$, $p_2 = 0.50$, OR = 8.16, level of significance = 5%, power of the test = 80%). The definition of perioperative cardiovascular complications was the episode of myocardial injury, myocardial ischemia, and cardiac arrest diagnosed by clinical and confirmed by electrocardiogram and/or cardiac enzyme. A statistical analysis was used to identify anesthetic risk factors related to the complications.

2. To determine factors associated with the perioperative death, the authors separated intracranial surgical patients into two groups by simple randomization with SPSS software version 11.5. The control group was composed of 252 patients who survived at least 72 hours postoperatively. The study group was composed of 84 patients who died within 72 hours postoperatively. The number of patients in the study group should not be less than 23. The sample size was calculated from the study of Wolters U, et al[8] who found that the ASA physical status 3-5 patients have a powerful correlation with perioperative death and the incidence studied by Charuluxananan S, et al[2] ($p_1 = 0.94$, $p_2 = 0.49$, OR = 16.22, level of significance = 5%, power of the test = 80%). A statistical analysis was used to identify anesthetic risk factors related to perioperative death.

The quantitative data are shown as number, percent, and standard deviations. The qualitative data were analyzed by Chi-Square test with the statistical significance at p-value of less than 0.05. Then, the multiple logistic regression analysis was used to identify risk factors and the strength of the association was shown as Odds ratio with 95% confidence intervals.

Results

The seven thousand four hundred and thirty patients were categorized into perioperative cardiovascular complications and perioperative death within

Table 1. Demographic and administrative characteristics of intracranial surgical patients

Data	Total intracranial surgical patients	Perioperative cardiovascular complication	Perioperative death
Sex			
Male	4473 (60.2)	46 (73.0)	61 (72.6)
Female	2957 (39.8)	17 (27.0)	23 (27.4)
Age (year)	41.6 ± 21.4	42.2 ± 20.6	39.3 ± 20.0
Weight (Kg)	54.3 ± 16.7	54.5 ± 16.5	55.4 ± 15.4
Anesthetic duration (minute)	165.6 ± 132.5	121.6 ± 91.1	109.7 ± 80.8
ASA physical status			
1	998 (13.4)	2 (3.2)	1 (1.2)
2	2722 (36.6)	5 (7.9)	4 (4.8)
3	2616 (35.2)	16 (25.4)	24 (28.6)
4	1022 (13.8)	29 (46.0)	46 (54.8)
5	72 (1.0)	11 (17.5)	9 (10.7)

Values shown as frequency (%), mean ± SD

Table 2. Anesthetic characteristics of intracranial surgical patients

Anesthetic factors	Total intracranial surgical patients	Perioperative cardiovascular complication	Perioperative death
Absence of anesthesiologists	1695 (22.8)	24 (38.1)	30 (35.7)
Invasive monitoring	2423 (32.6)	21 (33.3)	21 (25.0)
Endtidal carbondioxide monitoring	4456 (60.0)	27 (42.9)	29 (34.5)
Anesthetic technique			
- Hypotensive	88 (1.2)	3 (4.8)	3 (3.6)
- Hypothermia	12 (0.2)	0 (0)	1 (1.2)
Anesthetic agents			
- Pentothal	1157 (15.6)	7 (11.1)	7 (8.3)
- Propofol	4972 (66.9)	26 (41.3)	39 (46.4)
- Ketamine	19 (0.3)	0 (0)	0 (0)
- Midazolam	1238 (16.7)	16 (25.4)	21 (25.0)
- Succinyl Choline	848 (11.4)	1 (1.6)	2 (2.4)
- Pancuronium	2537 (34.1)	25 (39.7)	31 (36.9)
- Atracurium	933 (12.6)	6 (9.5)	6 (7.1)
- Cis-atracurium	482 (6.5)	1 (1.6)	0 (0)
- Vecuronium	2806 (37.8)	27 (42.9)	41 (48.8)
- Rocuronium	560 (7.5)	2 (3.2)	2 (2.4)
- Nitrous oxide	5517 (74.3)	39 (61.9)	54 (64.3)
- Halothane	247 (3.3)	2 (3.2)	3 (3.6)
- Isoflurane	6195 (83.4)	49 (77.8)	67 (79.8)
- Sevoflurane	653 (8.8)	1 (1.6)	2 (2.4)
- Morphine	340 (4.6)	0 (0)	0 (0)
- Fentanyl	6749 (90.8)	54 (85.7)	75 (89.3)
- Prostigmine	3551 (47.8)	11 (17.5)	17 (20.2)

Values shown as frequency (%)

72 hours as a demographic data in Table 1.

The emergency cases were found in 4128 (55.6%) with 78 (92.9%) deaths and 56 (88.9%) had perioperative cardiovascular complications. There were 96.4% in the perioperative death group and 93.7% in the perioperative cardiovascular complication group had abnormal pre-anesthetic conditions which were assessed by anesthetic personnel. The patients who received benzodiazepine for premedication were found in 6.3%, steroid 6.3% in the perioperative cardiovascular complication group and 9.5% and 3.6% in the perioperative death orderly. The presence of anesthesiologists, monitoring, special anesthetic technique and anesthetic agents are shown in Table 2.

From univariate analysis, factors were related to perioperative cardiovascular complications and perioperative death. The results that had statistical significance are illustrated in Table 3-4.

Then the authors used the logistic regression to find the correlation factors without any confound-

Table 3. Anesthetic factors related to perioperative cardiovascular complications in intracranial surgery (univariate analysis)

Anesthetic factors	Odds ratio	95% Confidence interval	p-value
Female	2.23	1.19-4.18	0.011
ASA physical status 3-5	8.44	3.67-19.76	<0.001
Emergency case	6.82	2.96-15.75	<0.001
Absence of anesthesiologist	3.14	1.66-5.94	<0.001
Absence of endtidal carbondioxide monitor	1.98	1.11-3.53	0.019
Non nitrous oxide usage	1.91	1.04-3.51	0.041

Table 4. Anesthetic factors related to perioperative death in intracranial surgery analyzed (univariate analysis)

Anesthetic factors	Odds ratio	95% Confidence interval	p-value
Male	1.89	1.10-3.25	0.022
ASA physical status 3-5	15.80	6.19-40.33	<0.001
Anesthetic duration less than 6 hours	4.32	1.00-18.67	0.032
Emergency case	10.74	4.51-25.55	<0.001
No midazolam premedication	6.39	1.50-27.22	0.004
Absence of anesthesiologist	2.36	1.37-4.08	0.002
No steroid usage	6.03	1.82-19.94	0.001
Absence of endtidal carbondioxide monitor	2.74	1.64-4.59	<0.001
Non nitrous oxide usage	2.09	1.22-3.58	0.009

Table 5. Anesthetic factors which related to perioperative cardiovascular complications and perioperative death (multivariate analysis)

Anesthetic factors	Odds ratio	95% Confidence interval	p-value
Cardiovascular complication			
ASA physical status 3-5	5.77	2.33-14.27	<0.001
Absence of anesthesiologist	2.19	1.06-4.54	0.034
Perioperative death			
ASA physical status 3-5	10.14	3.42-30.02	<0.001
Emergency case	3.55	1.31-9.60	0.013
Absence of endtidal carbondioxide monitor	2.27	1.26-4.09	0.006

ing. This is illustrated in Table 5. The stepwise multiple logistic regression was evaluated and initiated the equations as follows. Y = 1.75 ASA physical status + 0.79 anesthesiologist – 4.023 for the correlation of anesthetic risk factors and perioperative cardiovascular complications and Y = 2.32 ASA physical status + 1.27 emergency case + 0.82 endtidal carbondioxide monitor –4.223 for the correlation of anesthetic risk factors and perioperative death.

Discussion

Among the intracranial surgery in Thailand between February 2003 and August 2004, the incidence of perioperative cardiovascular complication and perioperative death were found in 0.85% and 1.13% by sequence. These incidences are possibly not comparable to the other sources because virtually all of the researches are studied in general surgery not particularly on every procedure that takes place in the intracranium. Aarabi B et al[9] described the incidence of perioperative death in severe traumatic brain injury was 28%. Sperling MR et al[10] found 0.85 in 1000 patient-year in epilepsy surgery. Marina G et al[11] found 3% in intracerebral aneurysm surgery and Fiorani P et al[12] reported 0.7% after carotid endarterectomy and revealed 0.8% of perioperative cardiovascular complication.

In the present study, a large number of patients were categorized into the ASA physical status over 2, which defined the severity of disease. That was the reason why the incidence of perioperative death was above average similar to the previous report[13]. Furthermore, the emergency circumstance can increase mortality and morbidity[14] but the process of preanesthetic evaluation can minimize and improve good surgical outcome[15-17].

From univariate analysis, steroids generated a worse outcome but after being adjusted any confounding factors from multivariate analysis there was no statistical significance. Some advised steroids in craniopharyngioma[18] and idiopathic increase intracranial pressure[19], some did not[20,21] and some claimed as the justification of avascular necrosis of the hip[22].

There was a strong relation between perioperative cardiovascular complications and perioperative death[23]. The influence factor is the absence of anesthesiologists from the anesthetic team. In a preceding study they exemplified the same conclusion[24-26] for example, Silber JH et al reported the upsurge of perioperative death from 2.5/1000 to 3.8/1000[27]. Besides, from anesthetic personnel the medical equipment like capnometer also plays an important role in anesthesia. Several countries consider it as a basic monitor[28,29]. Endtidal carbondioxide monitoring does not prevent the post operative complication but reduces the incidence by warning[30]. The others asserted the intensity of morbidity and mortality for the nonappearance of effective monitors[31,32].

Nowadays the authors confronted the limitation of resources, manpower, and financial statement. The alternative of anesthetic trained from other medical recruits, referral system and competency for each professional would have an advantage. However, the beneficial evaluation to the patients and national health management should be deliberated. In summary, the present study, as part of the Thai Anesthesia Incidents Study, revealed that high ASA physical status, emergency condition, absence of certified board anesthesiologists, and absence or no monitoring of capnometry were predictors of cardiovascular complications and or perioperative death in intracranial surgical patients.

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References

1. Charuluxananan S, Suraseranivongse S, Punjasawadwong Y, Somboonviboon W, Nipitsukarn T, Sothikarnmanee T, et al. The Thai Anesthesia Incidents Study (THAI Study) of anesthetic outcomes: I. Description of methods and populations. J Med Assoc Thai 2005; 88(Suppl 7): S1-13.

2. 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.
3. Jamjoom A, Jamjoom ZA, Stranjalis G, Cummins B, Torrens M. The outcome of surgery of aneurysmal subarachnoid haemorrhage. Br J Clin Pract 1993; 47: 136-40.
4. Gerber CJ, Lang DA, Neil-Dwyer G, Smith PW. A simple scoring system for accurate prediction of outcome within four days of a subarachnoid haemorrhage. Acta Neurochir (Wien) 1993; 122: 11-22.
5. Schutz H, Krack P, Buchinger B, Bodeker RH, Laun A, Dorndorf W, et al. Outcome of patients with aneurysmal and presumed aneurysmal bleeding. A hospital study based on 100 consecutive cases in a neurological clinic. Neurosurg Rev 1993; 16: 15-25.
6. Hosoda K, Fujita S, Kawaguchi T, Shose Y, Hamano S, Iwakura M. Effect of clot removal and surgical manipulation on regional cerebral blood flow and delayed vasospasm in early aneurysm surgery for subarachnoid hemorrhage. Surg Neurol 1999; 51: 81-8.
7. Akavipat P, Dumrongbul K, Pannak S. The correlation of anesthetic factors and post-operative complications in patients with ruptured cerebral aneurysm. Thai J Anesthesiol 2006; 32: 55-62.
8. Wolters U, Wolf T, Stutzer H, Schroder T. ASA classification and perioperative variables as predictors of postoperative outcome. Br J Anaesth 1996; 77: 217-22.
9. Aarabi B, Hesdorffer DC, Ahn ES, Aresco C, Scalea TM, Eisenberg HM. Outcome following decompressive craniectomy for malignant swelling due to severe head injury. J Neurosurg 2006; 104: 469-79.
10. Sperling MR, Harris A, Nei M, Liporace JD, O'Connor MJ. Mortality after epilepsy surgery. Epilepsia 2005; 46(Suppl 11): 49-53.
11. Maira G, Anile C, Mangiola A, Paci A, Paci F, Frondizi D, et al. Pure surgical treatment of 109 aneurysms. J Neurosurg Sci 2005; 49: 31-8.
12. Fiorani P, Sbarigia E, Speziale F, Antonini M, Fiorani B, Rizzo L, et al. General anaesthesia versus cervical block and perioperative complications in carotid artery surgery. Eur J Vasc Endovasc Surg 1997; 13: 37-42.
13. Pedersen T. Complications and death following anaesthesia. A prospective study with special reference to the influence of patient-, anaesthesia-, and surgery-related risk factors. Dan Med Bull 1994; 41: 319-31.
14. Fasting S, Gisvold SE. Serious intraoperative problems - a five-year review of 83,844 anesthetics. Can J Anaesth 2002; 49: 545-53.
15. Wilson RJ, Woods I. Cardiovascular optimization for high-risk surgery. Curr Opin Crit Care 2001; 7: 195-9.
16. Weldon BC, Monk TG. The patient at risk for acute renal failure. Recognition, prevention, and preoperative optimization. Anesthesiol Clin North Am 2000; 18: 705-17.
17. Emerson CE, Rainbird A. Use of a 'hospital-at-home' service for patient optimization before resection of phaeochromocytoma. Br J Anaesth 2003; 90: 380-2.
18. Gonc EN, Yordam N, Ozon A, Alikasifoglu A, Kandemir N. Endocrinological outcome of different treatment options in children with craniopharyngioma: a retrospective analysis of 66 cases. Pediatr Neurosurg 2004; 40: 112-9.
19. Tang RA, Dorotheo EU, Schiffman JS, Bahrani HM. Medical and surgical management of idiopathic intracranial hypertension in pregnancy. Curr Neurol Neurosci Rep 2004; 4: 398-409.
20. Chesnut RM. Management of brain and spine injuries. Crit Care Clin 2004; 20: 25-55.
21. Hofmeijer J, van der Worp HB, Kappelle LJ. Treatment of space-occupying cerebral infarction. Crit Care Med 2003; 31: 617-25.
22. Wong GK, Poon WS, Chiu KH. Steroid-induced avascular necrosis of the hip in neurosurgical patients: epidemiological study. ANZ J Surg 2005; 75: 409-10.
23. Mangano DT. Perioperative cardiac morbidity - epidemiology, costs, problems, and solutions. West J Med 1994; 161: 87-9.
24. Silber JH, Williams SV, Krakauer H, Schwartz JS. Hospital and patient characteristics associated with death after surgery. A study of adverse occurrence and failure to rescue. Med Care 1992; 30: 615-29.
25. Silber JH, Rosenbaum PR, Ross RN. Comparing the contributions of groups of predictors: Which outcomes vary with hospital rather than patient characteristic? J Am Stat Assoc 1995; 90: 7-18.
26. Hartz AJ, Krakauer H, Kuhn EM, Young M, Jacobsen SJ, Gay G, et al. Hospital characteristics and mortality rates. N Engl J Med 1989; 321: 1720-5.

27. Silber JH, Kennedy SK, Even-Shoshan O, Chen W, Mosher RE, Showan AM, et al. Anesthesiologist board certification and patient outcomes. Anesthesiology 2002; 96: 1044-52.
28. ASA House of Delegates. Standards for basic anesthetic monitoring. 2005. Available from: http://www.asahq.org/publicationsAndServices/standards/02.pdf#2. (Accessed: July 12, 2005).
29. Buhre W, Rossaint R. Perioperative management and monitoring in anaesthesia. Lancet 2003; 362: 1839-46.
30. Runciman WB, Webb RK, Barker L, Currie M. The Australian Incident Monitoring Study. The pulse oximeter: applications and limitations - an analysis of 2000 incident reports. Anaesth Intensive Care 1993; 21: 543-50.
31. Webb RK, van der Walt JH, Runciman WB, Williamson JA, Cockings J, Russell WJ, et al. The Australian Incident Monitoring Study. Which monitor? An analysis of 2000 incident reports. Anaesth Intensive Care 1993; 21: 529-42.
32. Bhananker SM, Posner KL, Cheney FW, Caplan RA, Lee LA, Domino KB. Injury and liability associated with monitored anesthesia care: a closed claims analysis. Anesthesiology 2006; 104: 228-34.

ปัจจัยทางวิสัญญีวิทยาที่เกี่ยวข้องกับการเสียชีวิตและภาวะแทรกซ้อนทางระบบหัวใจและหลอดเลือดระหว่างและหลังการผ่าตัดกะโหลกศีรษะในโครงการศึกษาภาวะแทรกซ้อนทางวิสัญญีวิทยาในประเทศไทย

ภูพิงค์ เอกะวิภาต, วิชัย อิทธิชัยกุลฑล, ลาวัลย์ ตู้จินดา, เทพกร สาธิตการมณี, ศิริลักษณ์ กล้าณรงค์, ธารทิพย์ ประณุทนรพาล

วัตถุประสงค์: *เพื่อประเมินความสัมพันธ์ของปัจจัยเสี่ยงด้านวิสัญญีวิทยาที่เกี่ยวข้องกับภาวะแทรกซ้อนทางระบบหัวใจและหลอดเลือด และภาวะการเสียชีวิตระหว่างและหลังการผ่าตัดภายใน 72 ชั่วโมง*

วัสดุและวิธีการ: *ทำการศึกษาย้อนหลังในผู้ป่วยทั้งหมดที่ได้รับการผ่าตัดภายในกะโหลกศีรษะที่ได้ จากฐานข้อมูลของ Thai Anesthesia Incidents Study (THAI Study) ที่ทำการศึกษาในโรงพยาบาลในระดับต่าง ๆ 20 แห่งทั่วประเทศ โดยการวิเคราะห์ แบบ case controlled 1:3 เพื่อหาปัจจัยเสี่ยงต่าง ๆ ทางด้านวิสัญญีวิทยา ที่อาจเกี่ยวข้องกับภาวะแทรกซ้อนทางระบบหัวใจและหลอดเลือด และหาปัจจัยเสี่ยงที่อาจเกี่ยวข้องกับภาวะการเสียชีวิตระหว่างและหลังการผ่าตัด โดยใช้หลักการวิเคราะห์ทางสถิติแบบ Chi Square test และ multiple logistic regression โดยมีนัยสำคัญทางสถิติเมื่อ p-value < 0.05 และแสดงผลในรูปของ Odds ratio และ 95% confidence intervals*

ผลการศึกษา: *ผู้ป่วยทั้งหมดจำนวน 7,430 คน เป็นผู้ป่วยที่มีภาวะแทรกซ้อนทางระบบหัวใจและหลอดเลือด จำนวน 63 คน (0.85%) พบว่าการจำแนกผู้ป่วยตาม American Society of Anesthesiologists ระดับ 3-5 (OR 5.77, 95%CI 2.33-14.27) และการไม่มีวิสัญญีแพทย์ในทีมผู้ให้ยาระงับความรู้สึก (OR 2.19, 95%CI 1.06-4.54) มีความสัมพันธ์กับการเกิดภาวะแทรกซ้อนอย่างมีนัยสำคัญ ส่วนผู้ป่วยที่เสียชีวิตระหว่างและหลังการผ่าตัดภายใน 72 ชั่วโมงนั้นมีจำนวน 84 คน (1.13%) พบว่าการจำแนกผู้ป่วยตาม American Society of Anesthesiologists ระดับ 3-5 (OR 10.14 95%CI 3.42-30.02) ภาวะฉุกเฉิน (OR 3.55, 95%CI 1.31-9.60) และการไม่มีเครื่องเฝ้าระวังปริมาณคาร์บอนไดออกไซด์ในลมหายใจออก (OR 2.27, 95%CI 1.26-4.09) มีความสัมพันธ์กับการเสียชีวิตอย่างมีนัยสำคัญ*

สรุป: *ปัจจัยเสี่ยงของการเกิดภาวะแทรกซ้อนทางระบบหัวใจและหลอดเลือด ได้แก่ ASA physical status 3-5 และการไม่มีวิสัญญีแพทย์ในทีมให้การระงับความรู้สึก และปัจจัยเสี่ยงของการเสียชีวิตระหว่างและหลังการผ่าตัด ได้แก่ ASA physical status 3-5, ภาวะฉุกเฉินและการไม่มีหรือไม่ได้ใช้เครื่องวัดระดับคาร์บอนไดออกไซด์ในลมหายใจออก*