Original Article

Recovery Room Incidents from the First 2,000 Reports: Perioperative and Anesthetic Adverse Events in Thailand [PAAd Thai] Study

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Background: The Royal College of Anesthesiologists hosted the Perioperative and Anesthetic Adverse Events in Thailand [PAAd Thai] Study to investigate incidences and models of anesthesia related adverse events for suggested preventive strategies.

Objective: To investigate critical incidents occurring in the Post Anesthesia Care Unit [PACU].

Materials and Methods: Structured incident reports were requested to be filled in by anesthesia provider and/or site manager of 22 hospitals in Thailand. Critical incidents of interest occurred in the PACU between January 1 and December 31, 2015 and were sent for review by three senior anesthesiologists. Discussion and consensus was used to resolve any discrimination among reviewers. Descriptive statistics were used.

Results: Among 333,219 anesthetics, there were 221 incidents (10.5%) of the first 2,000 incident reports that occurred in the PACU. The most common critical incidents were respiratory complications (81%) such as reintubation (50.7%), oxygen desaturation (50.2%), suspected emergence delirium (6.6%), and anaphylaxis/anaphylactoid or allergic reaction (5.7%). Four cardiac arrests occurred with two deaths within 24 hours.

Conclusion: Twenty percent of the incidents were considered preventable. Regarding the model of anesthesia related adverse events, the contributing factors were inappropriate decision making, inadequate preanesthetic evaluation, and inexperience. The factors minimizing incidents were vigilance and having experience. Suggested corrective strategies are quality assurance activities, training, improvement of supervision, and communication. A handoff procedure using checklists was suggested for further improvement.

Keywords: Adverse event, Complication, Recovery room, Postanesthesia, Care unit, Quality, Safety

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Patient safety has been focused on in the health-care industry for decades, particularly in the field of anesthesia services. Providing safe and competent care is essential to good patient outcome. In anesthesia care, the 'do no harm' mandate is similarly evidenced as in other specialties. Patient-safety literature in medicine has been recently disseminated[1]. The Institute of Medicine's Report, To Err Is Human, also raises greater focus on human and organizational system error[2]. The Royal College of Anesthesiologists of Thailand [RCAT] started a multicenter registry in 2004 to 2005 to evaluate incidences of perioperative mortality and morbidity in 20 government hospitals[3,4]. In 2007, the Thai Anesthesia Study group organized a multicentered study model of anesthesia using an incident reporting system among 51 hospitals across Thailand[5,6]. It was

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found that besides intraoperative events, postoperative adverse events were also common[6].

Recovery room care comprises of an early phase during which monitoring and staffing ratios are nearly equivalent to those in the critical care unit, and late phase wherein transition is done from intensive observation to preparation for care in a hospital ward or at home. The concept of fast track recovery is emerging due to the development of new anesthetics, adjunctive drugs, and monitoring techniques. However, many hospitals are burdened with a Post Anesthesia Care Unit [PACU] that is remote from operating theaters. Since anesthesia services are also provided outside the operating theater such as in radiology and psychiatric wards etc., these external sites are at risk for postanesthetic complications. With these recent developments, the Thai Anesthesia Study group supported by the RCAT, initiated a second multi-centered project called the Perioperative and Anesthetic Adverse Event Study in Thailand [PAAd Thai] by incident reporting system in 2015 to follow-up the incidences of several anesthesia related adverse events including critical incidents that occurred in recovery rooms or PACU. The present study was aimed to investigate the natural history of anesthesia related adverse events and study the model of anesthesia related complications occurring in the PACU.

Materials and Methods

This was a multicentered project hosted by the RCAT, in cooperation with eight academic-based or university hospitals and 14 service-based hospitals under the Ministry of Public Health across Thailand. All participating hospitals were invited to send monthly incident reports using structured critical incident case record forms[7]. The Institutional Ethical Review Board approved the study with exemption of informed consent as a result of the retrospective nature of this study and analysis of prospective data collection of critical incident reports.

The PAAd Thai incident report form was developed among delegates from participating hospitals who were familiar with the existing form used among Thai hospitals. All incidents in the PAAd Thai Study were reported with this form. Details of the structured incident report form has been described in previous study[7,8]. The first part is comprised of administrative, operative, and anesthetic data, and includes incidents of interest such as pulmonary aspiration, suspected pulmonary embolism, endobronchial intubation, oxygen desaturation (oxygen saturation less than 85% or less than 90% for at least three minutes), coma/cerebrovascular accident/convulsion, peripheral neurological deficit, transfusion mismatch, suspected myocardial infarction/ischemia, cardiac arrest/death, anaphylaxis/anaphylactoid reaction/allergy, medication error, and equipment malfunction. The second part of the incident report contains space for description of critical incident addressing what, why, when, where, and how the incident happened[7].

When a critical incident occurred, a PAAd Thai form must be filled out by the attending anesthesia personnel and sent to the site manager within 24 hours. The site manager then reviews the form to complete both structured data and narrative parts. The monthly collection of critical incident reports and monthly statistics are then sent to the Data Management Center at the Faculty of Medicine, Chulalongkorn University, Bangkok, Thailand. The project manager (Charuluxananan S) reviews case record forms and sends the data to be entered via a double entry technique. Statistical Analysis was used with SPSS program version 22. Descriptive statistics were used when appropriate[7].

Results

The Data Management Center at the Faculty of Medicine, Chulalongkorn University sent the incident reports of critical events that occurred at the recovery room or PACU to a reviewer group comprising of three senior anesthesiologists. Discrepancies among the three reviewers were solved by discussion towards consensus. Among 228 incident reports, seven reports were excluded due to non-relevance to definitions of adverse events of interest and incidents not occurring in the recovery room. Therefore, there were 221 reports for analysis. Age distribution of patients experiencing critical incidents in the PACU are shown in Figure 1. The min, max, mean (standard deviation) of patient

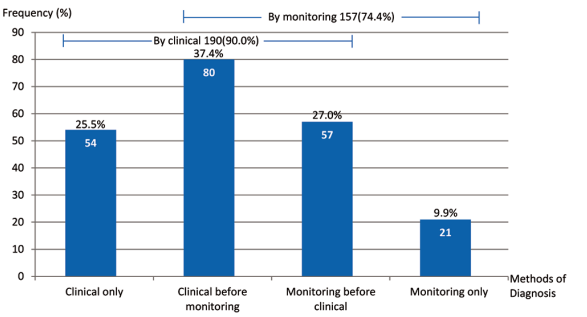

Figure 1. Methods of diagnosis of critical incidents in PACU (n = 211).

weight and height were 4, 170, 56.6 (22.3) kg and 45, 187, 154.9 (22.5) cm, respectively. Details of patient demographic and administrative characteristics in the present study are shown in Table 1. Duration of anesthesia varied from 33 minutes to 9 hours. There were 41 incidents (19.4%), 124 incidents (58.8%), and 37 incidents (17.5%) that occurred in patients receiving anesthesia and surgery with duration of less than one hour, one to three hours, and more than three hours, respectively. Types of surgery/sites of operation/ procedure and main anesthetic techniques among 221 incident reports are shown in Table 2. Ten patients (4.8%) received combined general anesthesia and either epidural, peripheral nerve block, or others techniques. Two hundred six patients (97.6%) were monitored with non-invasive blood pressure monitoring [NIBP], 28 patients (13.8%) with mean arterial pressure [MAP], 208 patients (98.6%) with pulse oximeter, 206 patients (97.6%) with electrocardiogram, 165 patients (78.2%) with capnometer, 64 patients (30.3%) with end-tidal gas monitoring, and 14 patients (6.6%) with central venous pressure [CVP].

The results of adverse incidents in 221 critical incident reports reviewed by three senior anesthesiologists are shown in Table 3. These critical incidents were diagnosed by clinical skill and monitoring equipment in 190 (90.0%) and 157 (74.4%) patients, respectively. Seventy-nine cases (37.9%) were diagnosed earlier by clinical skill than by monitoring equipment and 57 cases (27.0%) by clinical skill after monitoring equipment diagnosis. Diagnoses achieved by clinical skills alone was 54 incidents (25.5%) and by monitoring equipment alone was 21 incidents (9.9%). The earliest monitoring equipment detection of adverse events were pulse oximeter in 139 incidents (65.9%) and electrocardiography in 11 incidents (5.0%).

Immediate (within 24 hours) and long-term outcomes (at 7-day) of critical incidents are shown in Table 4. Contributing factors, factors minimizing incident, and suggested corrective strategies are shown in Table 5.

One hundred seven (50.7%) and 106 (50.2%) cases of reintubation and oxygen desaturation, respectively were reported to the Data Management Center. Among

Table 1. Demographic and administrative characteristics of critical incident reports that occurred in recovery rooms (n = 211)

	n (%)
Gender	
Male	108 (51.2)
Female	103 (48.8)
Type of hospitals	
University hospital	97 (46.0)
Service-based hospitals	114 (54.0)
ASA PS	
I	23 (10.9)
II	70 (33.2)
III	101 (47.9)
IV	11 (5.2)
V	1 (0.5)
Emergency	69 (32.7)
Inpatient	165 (78.2)
Official hours	134 (63.5)

ASA PS = American Society of Anesthesiologists physical status

Table 2. Surgery sites of operations and main anesthetic techniques among 221 critical incidents

	n (%)
Surgery or sites of operation	
General	67 (31.8)
Orthopedic	32 (15.2)
Obstetric-gynecological	18 (8.6)
Urological	17 (8.1)
Neurological	16 (7.6)
Thoracic	11 (5.2)
Plastic	9 (4.3)
Otorhinolaryngological	8 (3.8)
Endoscopic	6 (2.8)
Cesarean delivery	6 (2.8)
Opthalmological	5 (2.4)
Vascular	5 (2.4)
Cardiac	4 (1.9)
Others	7 (3.3)
Main anesthetic techniques	
General anesthesia	190 (90.2)
General total intravenous anesthesia	5 (2.4)
Monitored anesthesia care	4 (1.9)
Spinal anesthesia	11 (5.2)
Caudal anesthesia	1 (0.5)

Table 3. Critical incidents occurring in the recovery room or post anesthesia care unit (n = 211)

Critical incidents	n (%)
Reintubation	107 (50.7)
Oxygen desaturation	106 (50.2)
Suspected emergence delirium	14 (6.6)
Anaphylaxis/anaphylactoid/allergy	12 (5.7)
Coma/CVA/convulsion	11 (5.2)
Cardiac arrest	4 (1.8)
Death	3 (1.4)
Suspected myocardiac infarction/ischemia	3 (1.4)
Suspected pulmonary embolism	3 (1.4)
Peripheral neurological deficit	2 (0.9)
Transfusion mismatch	2 (0.9)
Difficult intubation	1 (0.5)
Esophageal intubation	1 (0.5)

CVA = cerebrovascular accident

106 cases of oxygen desaturation that occurred at the PACU, 35 patients (33.0%) developed desaturation immediately after arrival to the PACU. Demographic and perioperative characteristics are shown in Table 3. There was an incident that occurred during changing of endotracheal intubation in the PACU due to difficult intubation, a case of postoperative atelectasis by chest X-ray, a case of pneumothorax, and two cases of plural effusion after percutaneous nephrolithotomy [PCNL]. Incidents of oxygen desaturation necessitating re-intubation occurred in 40 cases (37.7%). Characteristics of patients who experienced oxygen desaturation in the PACU are shown in Table 6. There was one case of desaturation with suspected pulmonary embolism and another two cases of pulmonary embolism diagnosed by echocardiography or other imaging techniques. Two cases had complete recovery and another became vegetative.

Three cases had cardiac arrest that occurred in the PACU. The first cardiac arrest case occurred before arrival at the PACU and was excluded. The other two cases were due to patient condition, emergency situation, and surgical causes such as surgical complication and 7-hour operation duration. All cardiac arrest cases

Table 4. Immediate and long-term outcomes (7 days) after critical incident (n = 221)

	n (%)
Immediate outcome (within 24 hours)	
Unplanned ICU admission	45 (21.3)
Prolonged emergence	4 (1.9)
Minor physiological changes	7 (3.3)
Major physiological changes	152 (72.0)
Respiratory system	132 (62.6)
Cardiovascular system	6 (2.8)
Neurological system	15 (7.1)
Cardiac arrest	5 (2.4)
Death	2 (0.9)
Complete recovery	86 (40.8)
Long-term outcome (at 7 days)	
Prolonged ventilator support	57 (27.0)
Prolonged hospital stay	23 (10.9)
Vegetative state	5 (2.4)
Death	4 (1.9)
Complete recovery	61 (28.9)

ICU = intensive care units

Data are not mutually exclusive

Table 5. Contributing factors, factors minimizing, incidents, and suggested corrective strategies among incidents occurring in the recovery room

	n (%)
Contributing factors	
Inappropriate decision making	89 (42.2)
Inadequate preanesthetic evaluation	50 (23.7)
Inexperience	45 (21.3)
Haste	23 (10.1)
Emergency condition	15 (7.1)
Communication problems	9 (4.3)
Inadequate knowledge	6 (2.8)
Inadequate space in ICU	8 (3.8)
Others (personnel, monitor, blood bank, etc.)	12 (5.7)
Factors minimizing incidents	
Vigilance	132 (62.6)
Having experience	106 (50.2)
Experienced assistant	41 (19.4)
Communication system	18 (8.5)
Consultation (Inter/intra department)	9 (4.3)
Improvement of training	4 (1.9)
Comply to guideline	4 (1.9)
Increase of monitoring equipment	3 (1.4)
Others (personnel, equipment)	4 (1.9)
Suggested corrective strategies	
Quality assurance activity (M-M conference, etc.)	119 (56.4)
Continuing education & training	42 (19.9)
Improve supervision	39 (18.5)
Improve communication	35 (16.6)
Increase of manpower	7 (3.3)
Increase of monitoring equipment	6 (2.8)

M-M = mortality and morbidity

Table 6. Characteristics of patients experiencing oxygen desaturation in the PACU (n = 106)

	n (%)
Age	
>65 years	33 (31.1)
<10 years	10 (9.4)
Underling disease/status	
Cardiovascular disease	8 (7.5)
Respiratory disease	7 (6.6)
Chronic kidney disease	5 (4.7)
Clinical sepsis	5 (4.7)
Obese (BMI >35)	6 (5.6)
Operation site of surgery	
Upper abdomen	11 (10.3)
Thoracotomy	4 (3.8)
Intraoral surgery ENT	9 (8.5)
Neurosurgery	5 (4.7)
Endoscopy and bronchoscopy	7 (6.6)
Urological surgery	5 (4.7)
Duration of anesthesia	
Duration >3 hours	21 (19.8)
Duration <1 hour	27 (25.5)
Training education	8 (7.5)
Anesthesia related condition	
Training of nurse anesthetist trainees	8 (7.5)
Suspected medication related	
Opioids	21 (19.8)
Midazolam	8 (7.5)
Nondepolarizing muscle relaxant	10 (9.4)
Incidents occurred after pain medication	7 (6.6)
Suspected volume overload	9 (8.5)
Clinical appearance when occurred	
Upper airway obstruction	32 (30.2)
Hypoventilation	12 (11.3)

PACU = post anesthesia care unit; ENT = ear, nose, and throat

lapsed into vegetative state on the seventh postoperative day.

Among 14 cases of suspected delirium diagnosed in the PACU, eight (57.1%), two (14.2%), and five (35.7%) cases were those aged over 65 years, younger than 10 years, and patients that received midazolam, respectively. Eight cases (57.1%) were considered as spontaneous occurrence, seven cases (50%) may have resulted from inadequate pain management, three cases (21.4%) were related to surgical duration of more than three hours, and 10 cases (71.4%) had complete recovery after treatment. There were 11 relevant incident reports of anaphylaxis/anaphylactoid reaction/allergic reaction occurring in the recovery room. One patient developed anaphylaxis after cefazolin intravenous injection with skin, cardiovascular and respiratory symptoms. Another developed skin lesions and hypotension. Both patients recovered after treatment with adrenaline. Among 11 critical incidents, nine (81.8%), three (27.3%), and one (9.4%) developed skin reaction, cardiovascular, and respiratory manifestation, respectively. Allergic reactions in nine patients were mild. Anesthesia personnel treated these reactions with adrenaline, chlorpheniramine, and dexamethasone in two (18.1%), seven (63.6%), and four (36.3%) cases, respectively. Agents or possible causative agents considered by reviewers were blood and blood products such as packed red cells or fresh frozen plasma, antibiotics such as cefazolin, cloxacillin, bone cement or methyl methacrylate, and unknown in six (54.5%), three (27.3%), one (9.4%), and one (9.4%) case, respectively. All incidents were considered as spontaneous or inevitable occurrence and had complete recovery after treatment. None of the patients had history of allergy to any medication.

Three cases developed myocardial ischemia in the PACU. They were diagnosed by electrocardiography and confirmed by laboratory test or coronary angiography. Among three cases, two (66.6%) were patients over 75 years with underlining conditions such as history of coronary heart disease and were considered as anesthesia related events such as inadequate fluid or blood replacement or inappropriate airway management. After diagnosis and treatment, all patient condition recovered within one week.

Reviewers analyzed the data collection forms provided by attending personnel and site manager of each hospital and considered adverse events related to patient, surgical, anesthetic, human, and system factors in 140 incidents (63.3%), 61 incidents (27.6%), 147 incidents (66.5%), and 18 incidents (8.1%), respectively. One hundred three incidents (48.8%) were considered as human factors while 95 incidents 42.9%), five incidents (2.2%), and three (1.3%) incidents were judged as knowledge-based, rule-based, and skill-based error, respectively. Ninety cases (40.7%) were considered as spontaneous or inevitable occurrences, while 40 cases (18.0%) were judged as preventable. Two incidents (0.9%) were considered as surgical safety, where checklists may help prevent those incidents.

Discussion

The PAAd Thai study group decided to analyze critical incidents in the first 2,000 incidents reported to the Data Management Center. The multicentered incident monitoring method might overcome institutional variations. Two hundred eleven incident reports (10.5%) occurred in the recovery room, which was the second common frequent adverse event to occur after those that happened in the operating theater[8]. The high incidence rate was in accordance to the previous Thai Anesthesia Incident Monitoring Study [Thai AIMS] in 2007[6], but a 6% higher proportion was reported in the Australian Incident Monitoring Study[9]. Insight into the etiology of these adverse events might help develop strategies to reduce these incidents in this vulnerable area. The age distribution of patients who experienced critical incidents in the PACU also revealed the increasing proportion of elderly patients, which was similar to other studies[10,11]. The difference in the present study was that the proportion of patients under 10 years of age was only 8%, which was less than the proportion of those among overall perioperative incidents in the PAAd Thai database[8]. The possible explanation is that pediatric patients pose high risk during anesthesia particularly in the induction and emergence phases. More than half of patients who developed incidents were in American Society of Anesthesiologist [ASA] physical status of III and IV. However, critical incidents occurred among all ASA physical status classifications. Two-thirds of incidents occurred in emergency condition. In the present study, a majority of incidents involved the respiratory system, particularly oxygen desaturation and reintubation. In a closed claim analysis, 7% of closed claims relates to incident occurring in the PACU, of which, 58% arose from respiratory incidents[12]. This suggested that adverse events may develop into legal incidents associated with mortality or morbidity. The finding was also in accordance with 90% of incidents occurring in patients

receiving general anesthesia while a minority received spinal anesthesia and other techniques[12]. The mode of specialties where a critical incident occurred were general, orthopedic, obstetric-gynecological, urological, and thoracic surgeries, which was similar to that of incidents occurred in perioperative periods[8]. Clinical skill and monitoring-only, could not detect the critical incident of 9.9% and 25.5%, showing that human and monitoring equipment had their own limitations in the detection of incidents. The present study also revealed a higher rate of capnometry use during general anesthesia than previous data[3,5,8]. Therefore, mandatory use of capnometry should be encouraged in the RCAT's guidelines.

Respiratory adverse events are among the most common critical incidents occurring in the PACU. Eighty-one percent of incidents were either oxygen desaturation or reintubation or both. The incidence of postoperative respiratory adverse events varied from 5% to 80%, which were different among patient populations or definition[13]. Among 106 incidents of oxygen desaturation, 35 incidents (33.0%) were detected early at arrival of PACU, which suggested direct or indirect anesthetic related complications despite the possibility of multifactorial factors leading to complications. However, this proportion is less than 55% of desaturation detected on arrival of the PACU in previous study[14] but comparable to several other studies[15-17]. The present study revealed multiple potential factors that may lead to oxygen desaturation such as patient age more than 65 years (31.1%), duration of anesthesia and surgery of more than three hours (19.8%), and duration of surgery of less than one hour (25.5%). Other common factors were upper airway obstruction (30.2%) and hypoventilation (11.3%). Anesthetic factors related to incidents were opioids (19.8%), midazolam (9.8%), and training of nurse anesthetists (2.5%). Moreover, oxygen desaturation occurred after pain medication in seven cases (6.6%). These were similar to previous studies where residual neuromuscular blockage[18], anesthetic agents[16], and age were risk factors[16]. Recently, a prospective multicenter study provided predictors of postoperative pulmonary complications such as age more than 80 years, upper abdominal surgery, intrathoracic incision, duration of surgery more than two hours, and emergency condition[19], which supports the present study. Reintubation in the PACU also shared half of patients affected with critical incidents while some of which also developed oxygen desaturation. Recently, there was a cohort that revealed the risk factors that lead to reintubation in recovery room such as age less than one-year, chronic pulmonary disease, emergency condition, operative time, airway surgery, thoracic surgery, and the use neuromuscular blocking agent[20].

Postanesthetic emergence agitation or suspected delirium after anesthesia was not common in the present study, which was similar to 5% in two prospective studies[21,22]. The incidents occurred in patients with some specific characteristics such as age more than 65 years, receiving midazolam, inadequate pain management, and more than three hours duration of anesthesia, which was in accordance to the Kim et al study[23]. Anaphylaxis or anaphylactoid reaction was rare and had complete recovery after treatment with adrenaline. Other allergic reactions that occurred in the PACU were mild. The possible causative agents were blood, blood products, opioids, and antibiotics despite no history of allergy in all cases.

There were also few serious complications that occurred in the PACU such as two comas, two cerebrovascular accidents, two convulsions, two pulmonary embolisms, and nine cardiac arrests. The possible explanations were that physicians are more likely to treat diseases in an aging population and in more advanced surgeries[24]. One-tenth of critically ill patients in Europe could not be admitted to the intensive care unit because of bed shortages, making the PACU a suitable alternative choice[25]. These incidents will be presented in subsequent studies.

Among immediate outcomes within 24 hours after incidents, one-fifth had unplanned ICU admission, two-thirds had respiratory system complications such as hypoxemia, and pulmonary edema, and two-fifths had complete recovery. Four cases developed cardiac arrest and two cases died within 24 hours. One-fourth and one-tenth of the incidents needed prolonged ventilatory support and longer hospital stay within seven days. Therefore, incident prevention and minimization are very crucial.

As for model of adverse events that occurred in the PACU, contributing factors were inappropriate decision making, inadequate preanesthetic evaluation, and inexperience. Interestingly, haste was considered as contributor in 10% of cases. Factors minimizing incidents were vigilance, having experience, experienced assistant, and communication system. Suggested corrective strategies for the PACU incidents were quality assurance activities, education and training, improvement of supervision, and communication. Handoffs from the operating theater to the PACU are

an important process and structured checklists were suggested[27]. A recent systemic review suggested several recommendations such as complete urgent clinical tasks before handoffs, all team members being present, and more training in team communication[28].

Conclusion

Critical incidents that occur in the PACU was the second most common after intraoperative incidents. Most were respiratory system complication such as oxygen desaturation and reintubation. Serious complications such as central nervous system incidents, myocardial ischemia or infarction, pulmonary embolism, and cardiac arrest were rare but could lead to harmful outcomes. Contributing factors were inappropriate decision making, inadequate preanesthetic evaluation, and inexperience. Factors minimizing incidents were vigilance, having experience, and experienced assistant. Suggested corrective strategies for PACU incidents were quality assurance activities, training, and improvement of supervision, and communication. Further study regarding the handoffs process, especially the use of checklists is suggested.

What is already known on this topic?

General anesthesia together with mechanical ventilation impair pulmonary function and may lead to detrimental outcomes in the postanesthetic period. Respiratory complications such as oxygen desaturation and reintubation are most common complications in the PACU. Some incidents may be preventable.

What this study adds?

The PACU is important location in the field of perioperative medicine. Serious complications such as cerebrovascular accidents, coma, convulsion, pulmonary embolism, myocardial ischemia/infarction are infrequent but might lead to fatality. Haste was considered to be a contributing factor. In Thailand, improvement of supervision of junior personnel, and improvement of communication is crucial.

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Potential conflicts of interest

None.

References

1. Sutcliffe KM. High reliability organizations (HROs). Best Pract Res Clin Anaesthesiol 2011; 25:133-44.
2. Kohn LT, Corrigan JM, Donaldson MS. To err is human: building a safer healthcare system. Washington, DC: National Academy Press; 2000.
3. 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.
4. 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.
5. Punjasawadwong Y, Suraseranivongse S, Charuluxananan S, Jantorn P, Thienthong S, Chanchayanon T, et al. Multicentered study of model of anesthesia related adverse events in Thailand by incident report (the Thai Anesthesia Incident Monitoring Study): methodology. J Med Assoc Thai 2007;90:2529-37.
6. Charuluxananan S, Suraseranivongse S, Jantorn P, Sriraj W, Chanchayanon T, Tanudsintum S, et al. Multicentered study of model of anesthesia related adverse events in Thailand by incident report (The Thai Anesthesia Incidents Monitoring Study): results. J Med Assoc Thai 2008;91:1011-9.
7. Punjasawadwong Y, Sriraj W, Charuluxananan S, Akavipat P, Ittichaikulthol W, Pitimanaaree S, et al. Perioperative and Anesthetic Adverse Events in Thailand (PAAd Thai) incident reporting study:

hospital characteristics and methods. Asian Biomed 2017;11:33-39.
8. Charuluxananan S, Sriraj W, Punjasawadwong Y, Pitimana-aree S, Lekprasert V, Werawatganon T, et al. Perioperative and anesthetic adverse events study in Thailand (PAAd Thai): incident reporting study: anesthetic profiles and outcomes. Asian Biomed 2017;11:21-32.
9. Van der Walt JH, Webb RK, Osborne GA, Morgan C, Mackay P. The Australian Incident Monitoring Study. Recovery room incidents in the first 2000 incident reports. Anaesth Intensive Care 1993;21: 650-2.
10. Tamdee D, Punjasawadwong Y, Charuluxananan S, Tawichasri C, Sriprajittichai P, Kyokong O, et al. Factors related to intraoperative oxygen desaturation in geriatric patients in a Thai university hospital. J Med Assoc Thai 2009;92: 208-16.
11. Narasethkamol A, Charuluxananan S, Kyokong O, Premsamran P, Kundej S. Study of model of anesthesia related adverse event by incident report at King Chulalongkorn Memorial Hospital. J Med Assoc Thai 2011;94:78-88.
12. Zeitlin GL. Recovery mishaps in the ASA closed claims study. ASA Newsletter 1989;53:28-30.
13. Fisher BW, Majumdar SR, McAlister FA. Predicting pulmonary complications after non-thoracic surgery: a systematic review of blinded studies. Am J Med 2002;112:219-25.
14. Hintong T, Klanarong S, Suksompong S, Chua-in W, Chatmongkolchat S, Werawatganon T. The Thai Anesthesia Incident Monitoring Study (Thai AIMS) of oxygen desaturation in the post-anesthetic care unit. J Med Assoc Thai 2008;91: 1531-8.
15. Chripko D, Bevan JC, Archer DP, Bherer N. Decreases in arterial oxygen saturation in paediatric outpatients during transfer to the postanaesthetic recovery room. Can J Anaesth 1989;36:128-32.
16. Canet J, Ricos M, Vidal F. Early postoperative arterial oxygen desaturation. Determining factors and response to oxygen therapy. Anesth Analg 1989;69:207-12.
17. Tyler IL, Tantisira B, Winter PM, Motoyama EK. Continuous monitoring of arterial oxygen saturation with pulse oximetry during transfer to the recovery room. Anesth Analg 1985;64: 1108-12.
18. Xará D, Santos A, Abelha F. Adverse respiratory events in a post-anesthesia care unit. Arch Bronconeumol 2015;51:69-75.
19. Canet J, Gallart L, Gomar C, Paluzie G, Valles J, Castillo J, et al. Prediction of postoperative pulmonary complications in a population-based surgical cohort. Anesthesiology 2010;113: 1338-50.
20. Rujirojindakul P, Geater AF, McNeil EB, Vasinanukorn P, Prathep S, Asim W, et al. Risk factors for reintubation in the post-anaesthetic care unit: a case-control study. Br J Anaesth 2012; 109:636-42.
21. Lepousé C, Lautner CA, Liu L, Gomis P, Leon A. Emergence delirium in adults in the post-anaesthesia care unit. Br J Anaesth 2006;96: 747-53.
22. Hatzakorzian R, Shan WL, Cote AV, Schricker T, Backman SB. The management of severe emergence agitation using droperidol. Anaesthesia 2006;61:1112-5.
23. Kim HC, Kim E, Jeon YT, Hwang JW, Lim YJ, Seo JH, et al. Postanaesthetic emergence agitation in adult patients after general anaesthesia for urological surgery. J Int Med Res 2015;43:226-35.
24. García PS, Duggan EW, McCullough IL, Lee SC, Fishman D. Postanesthesia care for the elderly patient. Clin Ther 2015;37:2651-65.
25. Heming N, Quesnel C, Chastrusse M, Pham T, Fischler M, Ferrand E. Critically ill patients admitted in post-anaesthesia care units: a survey of current practices in France. Br J Anaesth 2014; 113:295-6.
26. Ziser A, Alkobi M, Markovits R, Rozenberg B. The postanaesthesia care unit as a temporary admission location due to intensive care and ward overflow. Br J Anaesth 2002;88:577-9.
27. Robins HM, Dai F. Handoffs in the postoperative anesthesia care unit: Use of a checklist for transfer of care. AANA J 2015;83:264-8.
28. Segall N, Bonifacio AS, Schroeder RA, Barbeito A, Rogers D, Thornlow DK, et al. Can we make post-operative patient handovers safer? A systematic review of the literature. Anesth Analg 2012;115: 102-15.

อุบัติการณ์ที่เกิดในห้องพักฟื้นจากฐานข้อมูล 2,000 รายงานแรก: การศึกษาภาวะแทรกซ้อนของผู้ป่วยที่ได้รับยาระงับความรู้สึกและผ่าตัดในประเทศไทย (PAAd Thai Study)

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ภูมิหลัง: ราชวิทยาลัยวิสัญญีแพทย์แห่งประเทศไทยให้การสนับสนุนโครงการวิจัย ภาวะแทรกซ้อนที่เกี่ยวข้องทางศัลยกรรม และวิสัญญีวิทยาในประเทศไทย เพื่อศึกษาอุบัติการณ์และแบบจำลองการเกิดภาวะแทรกซ้อนเพื่อหามาตรการป้องกัน

วัตถุประสงค์: เพื่อการศึกษาอุบัติการณ์ที่เกิดในห้องพักฟื้น

วัสดุและวิธีการ: บุคลากรวิสัญญีผู้ให้ยาระงับความรู้สึกหรือวิสัญญีแพทย์ ผู้ให้ยาระงับความรู้สึกในแต่ละโรงพยาบาลจาก 22 โรงพยาบาลในประเทศไทยเป็นผู้กรอกแบบฟอร์มรายงานอุบัติการณ์ และรวบรวมพร้อมสถิติรายเดือน โดยมีวิสัญญีแพทย์อาวุโส 3 คน ทำการทบทวนและพิจารณาร่วมกัน ในกรณีที่มีข้อขัดแย้งจะมีการอภิปรายจนได้ข้อสรุป นำเสนอโดยใช้สถิติเชิงพรรณนา

ผลการศึกษา: ในจำนวนผู้ป่วยที่ได้ยาระงับความรู้สึกทั้งหมด 333,219 ราย มีรายงานอุบัติการณ์ภาวะแทรกซ้อนที่ห้องพักฟื้น 221 รายงาน (ร้อยละ 10.5 ของ 2206 รายงาน) ภาวะแทรกซ้อนที่พบบ่อย ได้แก่ ภาวะแทรกซ้อนทางระบบทางเดินหายใจ (ร้อยละ 80) ได้แก่ การใส่ท่อช่วยหายใจซ้ำหลังถอดท่อหายใจ (ร้อยละ 50.7) ภาวะระดับความอิ่มตัวของออกซิเจนต่ำ (ร้อยละ 50.2) ภาวะสับสนวุ่นวายหลังการให้ยาระงับความรู้สึก (ร้อยละ 6.6) ภาวะอนาไฟแลกซิสหรือภาวะแพ้ (ร้อยละ 5.7) ผู้ป่วยหัวใจหยุดเต้น 4 ราย และเสียชีวิตภายใน 24 ชั่วโมง 2 ราย ร้อยละ 40 ของผู้ป่วยในรายงานอุบัติการณ์กลับมาเป็นปกติภายใน 24 ชั่วโมง ขณะที่อีกร้อยละ 28.9 กลับมาเป็นปกติภายใน 7 วัน

สรุป: อุบัติการณ์ที่เกิดขึ้น สำหรับการเกิดภาวะแทรกซ้อนที่ห้องพักฟื้นเป็นอุบัติการณ์ที่อาจป้องกันได้หนึ่งในห้าของอุบัติการณ์ ปัจจัยนำได้แก่ การตัดสินใจไม่เหมาะสม การประเมินผู้ป่วยก่อนให้ยาระงับความรู้สึกยังไม่เพียงพอ ขาดประสบการณ์ ปัจจัยลดอุบัติการณ์ ได้แก่ ความรอบคอบระแวดระวัง การมีประสบการณ์ กลยุทธ์ในการป้องกันอุบัติการณ์ ได้แก่ กิจกรรมพัฒนาคุณภาพ การฝึกอบรมเพิ่มเติม การปรับปรุงการควบคุม และเป็นที่ปรึกษา ตลอดจนการปรับปรุงการติดต่อสื่อสาร การศึกษานี้เสนอแนะให้พัฒนาระบบการส่งต่อข้อมูล โดยเฉพาะอย่างยิ่งการใช้ checklist ซึ่งควรทำการศึกษาและประเมินต่อไป