Original Article

The Perioperative and Anesthetic Adverse Events in Thailand (PAAd Thai) Study: 58 Case Reports of Obesity Patients

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Background: The Royal College of Anesthesiologists of Thailand (RCAT) contributed to a multicenter study, the Perioperative and Anesthetic Adverse Events in Thailand study (PAAd Thai) in 22 hospitals across Thailand. In the past two decades, the number of obese patients increased at an alarming rate.

Objective: To investigate natural history of anesthesia or surgical related complications, contributing factor and corrective strategies in patients whose body mass index (BMI) was equal or higher than 35 kg/m^2.

Materials and Methods: The present study was prospective descriptive study. After being approved by each Institutional Ethical Committee, written informed consents were waived. Each hospital was asked to anonymously report incidence of anesthesia related adverse events. Two thousand two hundred six incidence reports were provided. Patient with a BMI equal or over 35 kg/m^2 that underwent surgery were selected from the incident reports. Data were discussed and analyzed by three senior anesthesiologists for contributing factors, clinical courses, factors minimizing incident, and suggested corrective strategies.

Results: Fifty-eight cases (2.63%) from the 2,206 reports of the PAAd Thai Study met the inclusion definition and were reviewed. Seventy-eight incidents occurred from 3,028 critical incidents reports (2.57%), one-third was male and the rest were female. The average age was 39.96±6.72 year and BMI was 39.8±5.1 kg/m^2. The highest incidence occurred in patients with BMI 35 to 39.9 kg/m^2 (65.52%). Half was classified as the ASA physical status 3. The adverse events were found more frequent in elective surgery (40 incidents or 68.96%) than emergency surgery. General surgery such as laparotomy had higher incidence compared to other surgical specialties. Oxygen desaturation was the most common incident (51.7%). Severe arrhythmia, difficult intubation, and cardiac arrest in 24 hours post-operatively were found in the same frequency (12.1%). Contributing factors from the present report were inadequate preanesthetic evaluation and preparation, inexperience, inappropriate decision, and urgency. Having experiences, more vigilance, and experienced assistant or effective supervision were factors for minimizing outcomes.

Conclusion: Improvement of supervision, additional training, and clinical practice guidelines were suggested for corrective strategies.

Keywords: Obesity, Overweighted, Desaturation, Arrhythmia, Difficult intubation, Reintubation, Cardiac arrest

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According to the World Health Organization (WHO) in 2014, more than 39% of the global adult population was overweight and 13% classified as obese[(1)]. This change also affected the population in Thailand. In the past two decades, the number of morbid obesity population is rising, and obesity prevalence in Thailand increased by more than 2.5 times[(2)]. In 2009, 41% of females, 28% of males, and almost 10% of Thai children were obese. Results of the 2014 survey showed that the prevalence of obesity in males reflected the trend from previous years and rose to 33%, while the prevalence in females increased

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only slightly to 43%. Thailand has now become one of the countries with the highest prevalence of obesity in Asia (second only to Malaysia), ahead of the Republic of Korea, Japan, and Singapore[3]. The challenges of anesthesia in this population become more frequent and is a problem for all anesthesiologists.

In 2015, the Royal College of Anesthesiologists of Thailand (RCAT) contributed to a multicenter study, the Perioperative and Anesthetic Adverse Events in Thailand study (PAAd Thai), which has been a continuous process since the first Thai Anesthesia Incidents Study (THAI Study) in 2005 and Thai Anesthesia Incidents Monitoring Study (Thai AIMS) in 2007. All these studies were attempts to look for and collect the factors associated with anesthetic adverse events. Policies and habit have been changed based on the outcomes of the first two studies, which improved anesthesia quality and patient safety standard.

The present study was aimed to determine the frequency of incidents related to anesthetic complications, contributing factors, and corrective strategies in patients whose body mass index (BMI) were equal or over 35 kg/m² and underwent surgeries from the 2,206 incident reports in the PAAd Thai database.

Materials and Methods

The present study was part of the multicenter and prospective study, contributed by the RCAT in 22 hospitals across Thailand in 2015. After being approved by each Institutional Ethical Committee, written informed consents were waived. Each hospital was asked to anonymously report incident of anesthesia related adverse events that occurred within 24 hours of anesthesia by anesthesiologists or nurse anesthetists from each participating hospital as soon as possible after the adverse events. Data were collected and filled in standardized reporting forms between January and December 2015[4,5]. The definition of adverse events was found on the last page of the form[4]. Details of the adverse events were described in both closed-ended and open-ended questions. Demographic data, surgical factors, anesthetic factors, and systematic factors were recorded. Not only those, but contributing factors, factors minimizing, and suggested corrective strategies of the incidents were also reported. Three peer reviewers independently reviewed the completed record forms and made the consensus.

According to the WHO classification in Table 1, an obese patient was defined into three groups, mild obesity (BMI 30 to 34.9), severe obesity (BMI 35 to 39.9) and morbid obesity (BMI larger than 40). Class I obesity is associated with a "moderate risk", class II with a "high risk", and class III with a "very high risk" of mortality. Moreover, the American Society of Anesthesiologists (ASA) classifies morbid or extreme obesity (BMI of 40 to less than 50) and super morbid obesity (BMI of 50 or more). The ASA physical status 2 was defined in BMI greater than 30 kg/m² otherwise healthy but obese, and a morbid obese patient (BMI greater than 40 kg/m²) even without co-existing medical problems was used as an ASA physical status 3[6]. In the present study, report forms were selected by patients' BMI of 35 kg/m² or greater, from 2,206 incidents report and were discussed and analyzed by three reviewers for contributing factors, clinical courses, factors minimizing incident, and suggested corrective strategies.

Table 1. WHO classification[7] and ASA classifications[8]

	BMI (kg/m²)	ASA physical status
Class I obesity: mild obesity	30.0 to 34.9	2
Class II obesity: severe obesity	35.0 to 39.9	2
Class III obesity: morbid obesity	40.0 to 49.9	3

BMI=body mass index; ASA=American Society of Anesthesiologists

The data were analyzed by descriptive statistics using SPSS for Windows, version 22 (IBM Corp, Armonk, NY, USA).

Results

Fifty-eight cases (2.6%) were extracted as they met the BMI criteria of 35 kg/m² or greater, from the 2,206 cases of the PAAD Thai study. Seventy-eight incidents occurred from 3,028 critical incident reports (2.5%), which occurred in 333,219 cases data collections. The 58 cases included 21 males (36.2%) and 37 females (63.8%) (Table 2, 3). The average age was 39.9±6.7 year and BMI was 39.8±5.1 kg/m². The highest incidence occurred in patients with BMI 35 to 39.9 kg/m² (65.5%). Thirty-one cases (53.4%) were classified as ASA physical status 3. The adverse events were found more frequently in elective surgery (40 incidents or 68.9%) than emergency surgery. General surgery with exploratory laparotomy had the higher incidents compared to other surgical specialties as shown in Table 2.

Four patients in the present report were classified as super obese (with a BMI of 50 kg/m² or greater). All of these developed oxygen desaturation, two of

Table 2. Demographic and administrative characteristic of patients (n = 58)

Characteristics	n (%)
Sex	
Male	21 (36.2)
Female	37 (63.8)
Age range (years)	
<15	7 (12.1)
16 to 30	9 (15.5)
31 to 45	15 (25.9)
46 to 60	19 (32.8)
61 to 75	5 (8.6)
>76	3 (5.1)
BMI (kg/m^2)	
35 to 39.9	38 (65.5)
40 to 44.9	13 (22.4)
45 to 49.9	3 (5.1)
50 to 54.9	2 (3.5)
55 to 59.9	2 (3.5)
ASA physical status	
ASA 2	21 (36.2)
ASA 3	31 (53.5)
ASA 4	5 (8.6)
ASA 5	1 (1.7)
Emergency state	
Elective surgery	40 (69.0)
Emergency surgery	18 (31.0)
Hospital characteristic	
Academic directed	29 (5.0)
Service directed	28 (48.3)
Special service	1 (1.7)

BMI=body mass index; ASA=American Society of Anesthesiologists

Table 3. Surgical and anesthetic characteristics (n = 58)

Characteristics	n (%)
Type of surgery	
General surgery	15 (25.9)
• Open	13
• Laparoscope	2
Orthopedics	9 (15.5)
• Spine	6
• Others	3
Neurosurgery	2 (3.5)
• Spine	1
• Others	1
Obstetrical surgery	10 (17.2)
• Cesarean section	7
• Tubal resection	3
Gynecological surgery	4 (6.9)
Otolaryngological surgery	8 (13.8)
Opthalmological surgery	1 (1.7)
Cardiovascular thoracic surgery	2 (3.5)
Urological surgery	3 (5.1)
Bronchoscopy	2 (3.5)
Gastro-colonoscopy	1 (1.7)
Trauma	1 (1.7)
Anesthetic technique	
GA	49 (84.4)
RA	5 (8.6)
TIVA	2 (3.5)
MAC	2 (3.5)

GA=general anesthesia; RA=regional anesthesia; TIVA=total intravenous anesthesia; MAC=monitored anesthesia care

them recovered without consequences. One occurred from head down position during gynecological procedure and the other developed desaturation from laryngospasm at the time of surgical incision. The other two patients developed desaturation related to difficult intubation. After successful intubation, atelectasis and bradycardia occurred but the patients completely recovered.

In 16 morbidly obese patients (with a BMI of 40 to less than 50), nine patients had desaturation, three patients had arrhythmic events, nerve injuries were detected in three patients, and one patient had difficult intubation.

Most of the adverse events occurred in operating theatre (74.1%) as shown in Table 4. Table 5 shows that the critical incidents most common were oxygen desaturation (38.4%), severe arrhythmia (8.9%), cardiac arrest in the first 24 hours post-operatively (8.9%), difficult intubation (8.9%), and reintubation (7.6%), respectively. Five cases died in 24 hours (6.4%). The other incidents were hypotension (one case), coma at ward (one case) and suspected pulmonary emboli (two cases).

Oxygen desaturation was the most common incident that occurred from the data collected in the current study. Thirty patients developed desaturation mostly during intraoperative period, 36.6% occurred at the time of induction, 23.3% was detected at post-operative period. Average BMI was 41.2±6.1 but this incident was detected in 56.6% in patient with BMI between 35 to 39.9 kg/m² and ASA 3 (63.3%). Only nine patients (15.5%) developed desaturation during emergency.

Seven cases (12.1%) were reported difficult intubation (more than three times or more than 10

Table 4. Area of incidents occurred (n = 58)

Location	n (%)
Operating theatre	43 (74.1)
Endoscopic suite	1 (1.7)
Post-anesthesia care unit	7 (12.1)
Post-operative 24 hour	
Ward	5 (8.6)
Intensive care unit	2 (3.5)

Table 5. Critical incidents which commonly occurred (n = 58)

Incidents	n (%)
1. Oxygen desaturation	30 (51.7)
2. Difficult intubation	7 (12.1)
3. Severe arrhythmia	7 (12.1)
4. Cardiac arrest within 24 hours postoperatively	7 (12.1)
5. Reintubation	6 (10.3)
6. Nerve injury	5 (8.6)
7. Death	5 (8.6)
8. Esophageal intubation	4 (6.9)
9. Drug error	3 (5.1)
10. Others	4 (6.9)

Data was not mutually exclusive

minutes). All of those had hypoxia (oxygen saturation of less than 85% or less than 90% for more than three minutes). Video laryngoscopy or Glidescopes were used for assisting intubation in three cases. Five cases (71.4%) completely recovered in 24 hours, while, one patient needed post-operative ventilation support for three days. Another patient had airway obstruction after extubation and required emergency tracheostomy.

Severe arrhythmia, defined as atrial fibrillation with rapid ventricular response, ventricular tachycardia, ventricular fibrillation, or bradycardia, was found in seven patients. Four of them needed atropine treatment for bradycardia and had a complete recovery. Causes of bradycardia were varied as high level of subarachnoid block, peritoneal distension from surgical manipulation, upper airway obstruction during inhalation induction, and immediately occurred after extubation. Atrial fibrillation was reported in two cases, the first one also had heart failure together with hypotension during procedure and the other one had high analgesic level from spinal block to C1 level. Both had prolonged hospital stay and unplanned ICU admission. Surgical manipulation in penetrating chest injury during stopped bleeding induced ventricular tachycardia in the patient. ICU admission was already planned for this critically ill condition.

Five out of six patients (83.3%) had incident of reintubation that occurred in post-anesthesia care unit (PACU). One patient started to have mild dyspnea in PACU and was transferred to ward with developed agitation. Reintubation was done, and prolonged hospital stay for more than seven days. One had cardiac arrest and became vegetative state. The other had pulmonary emboli, cardiac arrest, and died in PACU.

Nerve injuries were detected in five patients (6.4%). Three patients were in morbid obesity group, one was under subarachnoid block, one under general anesthesia, and the last one under combined both techniques but developed paresthesia along her back and right leg at the time of anesthetic injection. Four of them were female. One patient receiving general anesthesia developed brachial plexus injury from prone position but recovered in 24 hours post-operative. The other was male patient that underwent laparoscopic gastric bypass under general anesthesia and reported numbness and weakness both arms post-operative. It improved after one week.

There were seven cases of cardiac arrest. Six cases occurred peri-operatively, and one case occurred intra-operatively. The six cases occurred within 24 hours postoperative period (Table 6) in the PACU, intensive care unit or in the ward (receiving mechanical ventilation). Five cases (71.4%) among these incidents developed fatal outcome.

Discussion

The present study was a part of the national study of perioperative and anesthetic adverse events in specific group of patients regarding overweight and obesity, which is continuously rising among Thai population. Fifty-eight patients (2.6%) of 2,206 incident report were included. The critical incidents occurred in university and service-based hospitals. The adverse events were found in female (63.8%) more than male (36.2%), which was in accordance to proportion of obese female and male in Thailand[2]. Majority of incidence occurred in patients that underwent general anesthesia. This might be explained by higher proportion of obese patients receiving general anesthesia.

Critical incidents occurred more frequently in class II obesity (BMI 35 to 39.9 kg/m^2) than in morbid obesity group. Despite a recent epidemiological study, the common prevalence of obesity among Thai population was 45 to 59-years-old followed by 33

Table 6. Cardiac arrest in 24 hours cases (n = 7)

Age (year)/ sex	ASA/ BMI	Diagnosis/ operation	Preoperative conditions	Main performer	Event location	Outcome in 24 hours
45/F	4E/39.1	Necrotizing fasciitis/ debridement	Sepsis	Nurse anesthetist, 1 year	Ward	Death
80/F	4/35.6	CBD stones/OC	DM, HT, elderly, sepsis	Nurse anesthetist	Intra-operative	Prolonged hospital stay, vegetative
53/F	3/37.1	Spinal stenosis/ posterior decompression L3-S1	DM, HT	Nurse anesthetist	PACU (7 hours operative) dead PO D5	Death
48/F	3E/44.4	Necrotizing fasciitis/ debridement	OSA, sepsis	Nurse anesthetist trainee	PACU	Vegetative, prolonged hospital stay
78/F	5E/35.6	Rupture AAA/ explore lap	DM, HT, stroke, bed ridden	MD, 2 years	Massive bleeding, post-operative 15 minutes in ICU	Death
17/F	3E/46.4	ITP/splenectomy	SLE, DM, HT, thrombocytopenia, ICH	MD, 7 years	PACU	Death
12/F	4E/37.5	NEC/small bowel resection	Hypoxia, sepsis	MD, 10 years	ICU	Death

ASA=American Society of Anesthesiologists; BMI=body mass index; F=female; M=male; CBD=common bile duct stones; OC=open cholecystectomy; AAA=abdominal aortic aneurysm; ITP=idiopathic thrombocytopenia; NEC=necrotizing entero colitis; DM=diabetes mellitus; HT=hypertension; OSA=obstructive sleep apnea; SLE=systemic lupus erythematous; ICH=intracerebral hemorrhage; ICU=intensive care unit; PACU=post-anesthetic care unit

to 44-years-old[2]. The present study revealed higher frequency of incidence in age group of 46 to 60 years (32.8%) than in age group of 31 to 45 years (25.86%).

Postoperative cardiac arrest within 24 hours occurred in seven cases. Four out of seven cases (57.1%) occurred in university hospitals, whereas the other three cases were in service-based hospitals. All patients had ASA physical status of 3 or more, and five out of seven cases (71.4%) underwent emergency surgery. Only two of them had BMI of 40 or more. In a multicenter study of obesity patients receiving gastric bypass, critical-ill conditions, and co-morbid disease were contributing factors of fatal outcomes and increased mortality risk scores[8]. In the present study, five cases died within 24 hours and the other two cases were in vegetative state.

In contrast to the previous study, most incidents in our patients were found in patients with BMI of less than 40 kg/m². The possible explanation was that most of obese population in Thailand were in class I and class II obesity. Tools such as STOP-BANG has been shown to reduce the need for intensive care when managing obese patient[11]. Neck circumference[12] and neck circumference to Thyromental distance[13] were not available in our data record forms. From the present study, only a few hospitals reported complete pre-operative screening in obese patients. Introducing specific pre-operative screening or scoring system for obese patient to prepare proper peri-operative care in these patients might be beneficial.

Peripheral nerve injury was reported four folds in obese patients compared with non-obese patients in one large study[9]. In the present study, five cases (8.6%) revealed common incidents of nerve injury, which occurred in both obese class II and morbidly obese patients. Two of them occurred from improper positioning during procedure. In the three other cases, the performers were aware of this complication during the intrathecally injection of the local anesthetics. More supervision and vigilance may be helpful. Developing protocol or guidance, specifically detailing this group of patients, might be required.

Myocardial ischemia has a high prevalence in obese patients. However, the present study found only severe arrhythmia and none of these were proved to be myocardial ischemia.

Several studies have shown that obesity is a risk factor of respiratory adverse events such as oxygen desaturation, difficult airway, bronchospasm, or atelectasis[14,15]. Oxygen desaturation was the

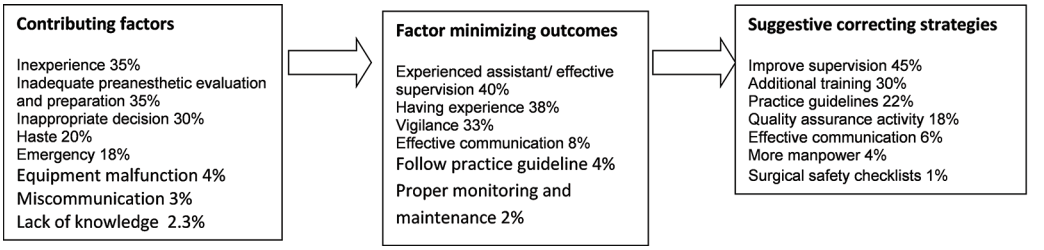

Figure 1. Contributing, factors minimizing outcomes, and suggested corrective strategic.

most common adverse events in the present study. More than half occurred intra-operatively, mostly at induction period. Every case reported difficult intubation also had desaturation and nearly all were assessed as preventable conditions. The techniques or procedures that can prevent or reduce these incidents should be made such as patient position in head-up or lateral[16] or apply nasal high flow cannula to maintain oxygenation[17]. Only two patients had already documented severe hypoxia before the operations due to critically ill conditions.

Difficult intubation was common (12.1%) and mostly succeeded with conventional techniques. There was no report of a lack of equipment. The need for more supervision and more experience was noticed in this critical incident.

Overall contributing factors from the present reports were inadequate pre-anesthetic evaluation and preparation, urgency, inexperience, and inappropriate decision. Having experiences, high vigilance, and having experienced assistant or effective supervision might be the factors for minimizing outcomes as shown in Figure 1.

The present study had some limitations. First, some incidents were probably under-reported. Second, all selected data were not totally complete in details, some might affect the outcome. Third, the present reported data were only adverse events and not the total number of patients. The results from the present study could not represent the real incidences of anesthetic practices in obese patients. However, factors related to those incidents might be of concern for personnel involved with this group of patients in the future.

Conclusion

Increasing obesity and morbid obesity population in our society require much more concern not only with the physiological changes but also with the diseases that come along with. Most adverse events are respiratory, which is oxygen desaturation. Contributing factors in most complications were found associated with urgency and inadequate patient preparations, which could be preventable. For anesthesiologists, perioperative management of obese patients require a high vigilance and additional skills. Specific scoring systems to evaluate risks prior to each procedure must be considered. Improving personnel competency care in PACU may help reduce the reintubation events by increasing personnel and revising the PACU protocol. Standard practice guidelines, improvement of supervision, additional training, and frequent quality assurance activities can minimize the adverse events and help improve quality and patient safety when undergoing anesthesia in obese patient.

What is already known on this topic?

Being overweight or obese is a significant problem during peri-operative management. Respiratory complications are more common adverse events during anesthesia because obesity is associated with multiple pulmonary comorbidities such as asthma and obstructive sleep apnea (OSA), according to the type of surgery.

What this study adds?

While BMI alone is not the perfect tool for outcome predictions in obese patients, it should not be ignored. BMI between 35 to 39.9 kg/m² in Thai population should be considered in risk assessment. For obese patients, specific training, more experienced personals combined with proper monitors, equipment, and ability to detect obesity-related comorbidities are required.

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Conflicts of interest

The authors declare no conflict of interest.

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