The Thai Anesthesia Incidents Study (THAI Study) of Ambulatory Anesthesia: II Anesthetic Profiles and Adverse Events

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Background: *There is a continuing trend to have more elective surgery performed on an outpatient basis.*
Objective: *To determine anesthetic profiles and adverse events in practice of ambulatory anesthesia for elective surgery in different levels of hospitals across Thailand.*
Material and Method: *A prospective descriptive study was conducted in 20 hospitals comprising seven university, five regional, four general and four district hospitals across Thailand. Consecutive patients undergoing anesthesia for elective surgery were included. The included patients, classified as outpatients, were selected and extracted for summary of the result by using descriptive statistics.*
Results: *The authors reported 7786 outpatients receiving anesthesia for elective surgery. The majority of patients were in ASA class 1 and 2 (96.2%) while the rest were in ASA class 3 (3.8%). Nearly 90% of the ASA class 3 patients were in university hospitals. The majority of patients (83.1%) did not receive premedication. Diazepam was used more frequently (11.5%* vs. *0.1%) than other drugs. Noninvasive blood pressure monitoring and pulse oximetry were used in greater than 90%, while electrocardiogram (EKG) was used in 67.2% and end tidal CO_2 in only 6.8%. The three most common anesthetic techniques were general anesthesia (including inhalation anesthetics), total intravenous anesthesia (TIVA), and monitored anesthesia care (MAC). Regional anesthesia was performed in 12% of cases. The three most common regional anesthetic techniques were brachial plexus block (7.1%), spinal anesthesia (2.21%), and other peripheral nerve blocks (2.06%). Propofol was the most common drug for induction. Succinylcholine was used for intubation in 8.8%. The three most common nondepolarizng neuromuscular blocking agents were atracurium, cisatracurium, and vecuronium. Fentanyl was the most common drug used among opioids. The three most common volatile anesthetics were sevoflurane, halothane, and isolurane. Lidocaine was the most frequently used in 29.76% of cases, while bupivacaine in 7.9% and ropivacaine only in 0.05%. The majority of the events relating to respiratory system were hypoxia or oxygen desaturation (18:10,000), reintubation (2.6:10,000) and difficult intubation (2.6:10,000), pulmonary aspiration (2.6:10,000), and esophageal intubation (1.3:10,000). Other adverse events included awareness (1.3:10,000), suspected myocardial infarction or ischemia (1.3:10,000), and drug error (1.3:10,000). Five patients (0.06%) received unplanned hospital admission. No patients developed cardiac arrest or died.*
Conclusion: *The incidence of major adverse events was low in ambulatory anesthesia for elective surgery when compared to the incidence in general surgical population. The majority of the events occurred in the respiratory system. The authors did not find any complications relating to regional anesthesia. Despite a low incidence of adverse events in ambulatory anesthesia, anesthesia personnel who are responsible for ambulatory anesthesia should have adequate knowledge and skills in selection and preparation of the patients. Therefore, a system of preanesthesia evaluation is very important.*

Keywords: *Ambulatory, Anesthesia, Outpatient*

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Ambulatory surgery as well as ambulatory anesthesia is a big challenge in Thailand. There are two reports regarding ambulatory anesthesia in Thailand[1,2]. One of the challenges affecting us, in ambulatory anesthesia, is to maintain favorable outcomes with a low complication rate. Therefore, the authors conducted the present study to find out the anesthesia profiles regarding anesthetic technique, monitoring, airway equipment, anesthetic agents, and adverse outcomes relating to ambulatory anesthesia in different levels of 20 hospitals across Thailand.

Material and Method

According to the Thai Anesthesia Incidents Study (THAI Study) protocol[3] approved by each institutional ethic committee of the 20 participating hospitals, consecutive outpatients receiving anesthesia for elective surgery were enrolled in the present study. The anesthesia profiles of these consecutive anesthetics consisted of anesthetic techniques, monitoring, airway equipment, anesthetics, and anesthesia adverse events. The adverse events of interest were pulmonary aspiration, undiagnosed esophageal intubation, hypoxemia or desaturation (SpO_2 < 85 or < 90 for more than 3 minutes), reintubation, difficult intubation (attempts > 3 times or duration of intubation longer than 10 min), failed intubation, total spinal block, awareness, coma/cerebrospinal accidents/convulsion, nerve injuries, transfusion mismatch, suspected myocardial ischemia or infarction, cardiac arrest, death, suspected malignant hyperthermia, analphylaxis/anaphylactoid reaction, drug error, anesthesia equipment malfunction or failure, anesthesia personnel hazard, unplanned hospital admission and unplanned intensive care unit (ICU) admission.

Attending anesthesia personnel or site managers were asked to fill in the preplanned structure data entry form (form 1) in addition to the usual anesthetic record. Whenever the adverse events of interest occurred, details of the events (except unplanned hospital and ICU admission) were recorded in the event specific data entry form (form 2). Patients were followed up until home readiness.

All forms were reviewed by a well-trained research nurse and/or a site manager for completeness. Verification and corrections were then made by a principal investigator of each center before submitting to the data management center.

Data collection and analysis: The data from each hospital were keyed at the data management center with double entry technique. Descriptive statistics was used for calculation of the occurrence rates of anesthesia-related adverse outcome.

Results

There were 7786 outpatients receiving anesthesia for elective surgery. Characteristics of the patients based on age groups and sex are shown in Table 1. The majority of cases were in the age group between 15 to 60 years (54.7%) while 22% was distributed in the extreme age groups, i.e. infants (6.7%) and the elderly (15.3%) and 23.4% in children aged between one to fifteen years. The proportion of females (55.8%) was higher than males (44.1%).Table 2 shows their distribution according ASA physical status class in each type of hospitals. Most of them (96.2%) were in ASA class 1 and 2, while 3.77% in ASA class 3. Nearly 90% of the ASA class 3 patients were in university hospitals. Table 3 presents the use of premedication. The majority of the patients (83.1%) did not receive premedication. Diazepam was used more frequently (11.5% vs. 0.1%) than Midazolam. Monitoring during anesthesia is shown in Table 4. Noninvasive blood pressure monitoring and pulse oximetry were used in greater than 90% of the patients, while electrocardiogram (EKG) was used in 67.2% and end tidal CO_2 in only 6.8%. Table 5 presents anesthetic techniques. The three most common anesthetic techniques were general anesthesia (including inhalation anesthetics), total intravenous anesthesia (TIVA), and monitored anesthesia care (MAC) with percentages of 49.12%, 22.67%, and 16.47%; respectively. Regional anesthesia was performed in 12% of cases. The three most common regional anesthetic techniques were brachial plexus block (7.1%), spinal anesthesia (2.21%) and other peripheral nerve blocks (2.06%). Airway management

Table 1. Distribution of cases according to age group and sex

Characteristics	n = 7786 (100%)
Age (years)	
0-1	521 (6.7%)
> 1-15	1819 (23.4%)
> 15-60	4256 (54.7%)
> 60	1190 (15.3%)
Sex	
Male	3437 (44.1%)
Female	4345 (55.8%)
Missing	4 (0.1%)

Value shown as number (%)

Table 2. Distribution of cases according to ASA physical status class stratified by type of hospitals

Type of hospitals	University hospital n = 7016	Regional hospital n = 656	General hospital n = 71	District hospital n = 43	Total n = 7786
ASA class 1	4330	510	47	36	4923 (63.2%)
ASA class 2	2397	142	23	7	2569 (33.0%)
ASA class 3	289	4	1	0	294 (3.77%)

Value shown as number (%)

Table 3. Premedication stratified by type of hospitals

Type of hospitals	University hospital n = 7016	Regional hospital n = 656	General hospital n = 71	District hospital n = 43	Total n = 7786
None	5717	647	63	42	6469 (83.1%)
Anticholinergic	25	0	0	0	25 (0.3%)
Midazolam	545	6	3	0	554 (0.1%)
Diazepam	895	0	1	0	896 (11.5%)
Ranitidine	5	0	0	0	5 (0.6%)

Value shown as number (%)

Table 4. Monitoring stratified by type of hospitals

Type of hospitals	University hospital n = 7016	Regional hospital n = 656	General hospital n = 71	District hospital n = 43	Total n = 7786
NIBP	6505	619	68	41	7233 (92.9%)
Pulse oximetry	6793	654	70	32	7549 (97.0%)
EKG	4775	417	19	18	5229 (67.2%)
End Tidal CO_2	524	2	2	0	528 (6.8%)
End tidal gas	14	1	0	0	15 (0.2%)
Temperature	12	0	0	0	12 (0.2%)
Urine output	79	11	6	0	96 (1.2%)
Esophageal stethoscope	8	0	0	0	8 (0.10%)
Chest piece stethoscope	481	153	14	0	648 (8.3%)
Peripheral nerve stimulator	0	0	0	0	0 (0%)
Airway pressure	568	9	7	0	584 (7.5%)

Value shown as number (%)

Table 5. Anesthetic technique stratified by type of hospitals

Type of hospitals	University hospital n = 7016	Regional hospital n = 656	General hospital n = 71	District hospital n = 43	Total n = 7786
General anesthesia	3257	518	42	8	3825 (49.12%)
Total intravenous anesthesia	1711	20	8	1	1765 (22.67%)
Monitored anesthesia care	1219	44	10	9	1282 (16.47%)
Spinal anesthesia	123	45	4	0	172 (2.21%)
Epidural anesthesia	45	0	0	0	45 (0.58%)
Combined spinal epidural	1	0	0	0	1 (0.01%)
Caudal block	3	0	0	0	3 (0.04%)
Brachial plexus block	526	20	7	0	553 (7.1%)
Other peripheral nerve block	127	9	0	25	161 (2.06%)

Value shown as number (%)

during anesthesia is described in Table 6. Regarding airway equipment, mask was used for maintaining anesthesia in 24% of patients while endotracheal anesthesia, via either oral or nasal route, was performed in 16.25% of patients. Whereas, larygeal mask anesthesia was applied in only 5.88%. Supplemented oxygen via either oxygen cannular or masks was given in 27.68% of cases. Anesthesia via tracheostomy, bronchoscopy, and jet ventilation was performed in a small percentage of the outpatients (3.4%) in large university hospitals. Details regarding anesthetic agents, neuromuscular blocking agents, narcotic analgesics and reversal agents are presented in Table 7. Propofol was a common intravenous anesthetic used in nearly half of the

Table 6. Airway equipment stratified by type of hospitals

Type of hospitals	University hospital n = 7016	Regional hospital n = 656	General hospital n = 71	District hospital n = 43	Total n = 7786
Orotracheal intubation	1108	75	21	2	1206 (15.50%)
Nasotracheal intubation	56	3	0	0	59 (0.78%)
Tracheostomy	137	1	0	0	138 (1.77%)
Laryngeal mask airway	440	16	2	0	458 (5.88%)
Mask	1431	420	17	2	1870 (24.01%)
Bronchoscope	49	14	0	0	63 (0.81%)
Jet	67	0	0	0	67 (0.86%)
Oxygen canular/mask	2045	92	18	0	2155 (27.68%)

Value shown as number (%)

Table 7. Anesthetics stratified by type of hospitals

Type of hospitals	University hospital n = 7016	Regional hospital n = 656	General hospital n = 71	District hospital n = 43	Total n = 7786
Pentothal	173	5	3	2	183 (2.35%)
Propofol	3272	309	23	1	3605 (46.3%)
Ketamine	183	8	18	2	211 (2.70%)
Diazepam	23	3	8	3	37 (0.48%)
Midazolam	1413	63	24	0	1500 (19.27%)
Succinylcholinen	611	60	12	2	685 (8.80%)
Pancuronium	149	9	3	2	163 (2.10%)
Atracurium	378	15	5	0	398 (5.1%)
Cisatrcurium	254	0	3	0	257 (3.30%)
Vecuronium	178	9	2	0	189 (2.43%)
Rocuronium	30	2	0	0	32 (0.41%)
Mivacurium	8	0	0	0	8 (0.10%)
Nitrous oxide	2991	503	39	6	3539 (45.50%)
Halothane	1232	179	20	0	1431 (18.15%)
Isoflurane	1055	139	3	1	1198 (15.39%)
Sevoflurane	1315	248	21	4	1588 (20.4%)
Desflurane	0	0	0	0	0
Morphine	138	32	7	0	177 (2.27%)
Fentanyl	3253	307	32	2	3594 (46.16%)
Pethidine	264	104	7	4	379 (4.87%)
Nalbuphne	7	0	0	0	7 (0.09%)
Lidocaine	2133	131	17	36	2317 (29.76%)
Bupivacaine	479	130	6	0	615 (7.90%)
Ropivacaine	4	0	0	0	4 (0.05%)
Atropine and prostigmine	914	31	14	2	961 (12.34%)

Value shown as number (%)

cases (46.3%) while pentothal was used only in 2.35%. Midazolam was used to supplement anesthesia or for sedation in 19.27% whereas diazepam was used only 0.48%. Succinylcholine was mainly used for endotracheal intubation in 8.8%. Atracurium, cisatracurium, and vercuronium were the three most common non-depolalizing neuromuscular blocking agents used during anesthesia with percentages of 5.1%, 3.3%, and 2.43%, while pancuronium was used in 2.10%. Among inhalation anesthetics, nitrous oxide was the most frequently used drug in 45.5% of patients. The percentages of the use of sevoflurane, halothane, and isoflurane were 20.4%, 18.15%, and 15.39% respectively. Nearly half of cases (46.16%) received fentanyl for supplemented analgesia while morphine and pethidine were less frequently used with the percentages of 2.27% and 4.87%, respectively. Among local anesthetic agents, lidocaine was the most frequently used in 29.76% of cases, while bupivacaine in 7.9% and ropivacaine only in 0.05%. About 12.34% of patients received atropine and prostigmine for reversal of neuromuscular block.

The anesthesia related adverse events are shown in Table 8. The majority of the events relating to respiratory system were hypoxia or oxygen desaturation (18:10,000), reintubation (2.6:10,000) and difficult intubation (2.6:10,000), pulmonary aspiration (2.6:10,000), and esophageal intubation (1.3:10,000). Other adverse events included awareness (1.3:10,000), suspected myocardial infarction or ischemia (1.3:10,000), and drug error (1.3:10,000). Five patients (6:10,000) received unplanned hospital admission. No patients developed cardiac arrest or died.

Discussion

Recent advances in anesthetic and surgical practices have facilitated the rapid growth in ambulatory surgery throughout the world[4]. Many studies in the field of ambulatory anesthesia have been published. Most studies focused on the anesthetic used[5-7], monitoring[8,10,11], postoperative pain relief[12], and recovery[8-13]. However, few studies have focused on the major adverse events in ambulatory anesthesia. The Thai Incidents Study (THAI Study) has developed a protocol and a standardized data entry form to monitor the adverse events during anesthesia. The authors used this protocol to follow up patients undergoing various elective surgical procedures on an outpatient basis. There were some drawbacks of this study. First, the authors were not able to obtain postoperative data after patients had been discharged. This could have led to miss some minor side effects unless the patients came back to the hospital. Therefore, a system to communicate with the patient after discharge is required. Second, the protocol did not intend to measure other interesting undesirable effects such as nausea/vomiting and pain. This should be included in the next protocol. Third, the protocol did not intend to study

Table 8. Number of cases with adverse events stratified by type of hospital

Type of hospitals	University hospital n = 7016	Regional hospital n = 656	Regional hospital n = 656	District hospital n = 43	Total n = 7786
Pulmonary aspiraton	2	0	0	0	2 (0.026%)
Esophageal intubation	1	0	0	0	1 (0.013%)
Hypoxemia	9	4	4	0	14 (0.18%)
Reintubation	2	0	0	0	2 (0.026%)
Difficult intubation	2	0	0	0	2 (0.026%)
Failed intubation	0	0	0	0	0 (0.00%)
Total spinal block	0	0	0	0	0 (0.00%)
Awareness	1	0	0	0	1 (0.013%)
Coma/CVA/convulsion	0	0	0	0	0 (0.00%)
Nerve injuries	0	0	0	0	0 (0.00%)
Transfusion mismatch	0	0	0	0	0 (0.00%)
Suspected MI	1	0	0	0	1 (0.013%)
Cardiac arrest	0	0	0	0	0 (0..00%)
Death	0	0	0	0	0 (0.00%)
Malignant hyperthermia	0	0	0	0	0 (0.00%)
Drug error	1	0	0	0	1 (0.013%)
Analphylactic/analphylactoid	0	0	0	0	0 (0.00%)
Unplanned hospital admission	5	0	0	0	5 (0.06%)

postoperative pain control. Hence, detail regarding pain control should be included in the protocol.

From the present study, the authors found that the expansion of ambulatory anesthesia was very slow and not uniformly distributed throughout Thailand. The majority of ambulatory anesthesia was practiced mostly in university hospitals in Bangkok. This variation may have been due to the difference in local needs, hospital policies, some environmental factors such as a problem of transportation and levels of ancillary service and need further investigation.

Regarding anesthetic profiles, the authors found that the majority of patients did not receive any premedication or preanesthetic evaluation before arriving in the operating theatre. A previous study has reported that there is a trend to increase the number of patients with diseases to have surgery on an ambulatory basis[1]. The authors also found that some of the patients in out patient studies had been classified in ASA physical status 3 or had underlying medical diseases. The three most common diseases found in out studied patients were hypertension, diabetes mellitus, and anemia. Therefore, a system of preanesthetic evaluation or premedication should be set up and evaluated. From the present study, the authors found the majority of the incident were related to respiratory events. Few patients developed complications after regional anesthesia. The rate of adverse events was very low when compared to the rate in general surgical patients.

In conclusion, the incidence of major adverse events was low in ambulatory anesthesia for elective surgery when compared to the incidence in general surgical population. The majority of the events occurred in the respiratory system. The authors did not find any complications relating to regional anesthesia. Despite a low incidence of adverse events in ambulatory anesthesia, anesthesia personnel who are responsible for ambulatory anesthesia should have adequate knowledge and skills in selection and preparation of the patients. Therefore, a system of preanesthesia evaluation is very important.

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การเฝ้าระวังภาวะแทรกซ้อนทางวิสัญญีในผู้ป่วยผ่าตัดแบบผู้ป่วยนอกในประเทศไทย: II ข้อมูลวิสัญญีและภาวะแทรกซ้อน

ยอดยิ่ง ปัญจสวัสดิ์วงศ์, สุรีรัตน์ ศรีสวัสดิ์, เทวารักษ์ วีระวัฒกานนท์, กนก ธราธารกุลวัฒนา, วราภรณ์ เชื้ออินทร์, มยุรี วศินานุกร

ภูมิหลัง: ปัจจุบันมีแนวโน้มที่มีการทำผ่าตัดในผู้ป่วยนอกที่ต้องกลับบ้านในวันเดียวกันมากขึ้น
วัตถุประสงค์: เพื่อศึกษาวิธีการให้ยาสลบ และอุบัติการณ์การเกิดภาวะแทรกซ้อนทางวิสัญญี
วัสดุและวิธีการ: เป็นการศึกษาแบบพรรณนาแบบไปข้างหน้า ในผู้ป่วยทุกรายที่เข้ามาตามลำดับสำหรับทำการผ่าตัดแบบ elective และคัดกรองเฉพาะผู้ป่วยที่ได้รับการบริการทางวิสัญญีแบบผู้ป่วยนอกและให้กลับบ้านในวันเดียวกันในโรงพยาบาล 20 แห่ง ซึ่งเป็นโรงพยาบาลมหาวิทยาลัย 7 แห่ง โรงพยาบาลศูนย์ 4 แห่ง โรงพยาบาลทั่วไป 4 แห่ง และโรงพยาบาลอำเภอ 4 แห่ง จากทุกภูมิภาคของประเทศไทย เพื่อนำข้อมูลมาสรุปโดยใช้สถิติเชิงพรรณนา
ผลการศึกษา: มีผู้ป่วยจำนวน 7,786 ราย ได้รับยาระงับความรู้สึกสำหรับการผ่าตัดแบบเตรียมการไว้ล่วงหน้า ส่วนใหญ่อยู่ใน ASA physical status class 1 และ 2 ส่วนน้อยอยู่ใน ASA class 3 ผู้ป่วยส่วนใหญ่ไม่ได้รับยา premedication Diazepamเป็นยาที่ใช้บ่อยกว่ายาตัวอื่น (11.5% vs 0.1 %) NIBP และ Pulse oximetry เป็นเครื่องมือเฝ้าระวังที่ใช้บ่อยมากกว่า 90% ส่วน EKGใช้ 67.2% สำหรับ end tidal CO_2 ใช้เพียง6.8% วิธีการให้ยาระงับความรู้สึกเรียงลำดับคือ ดมยาสลบแบบทั่วร่างกาย (49.1%) โดยการฉีดยาเข้าหลอดเลือดดำ (22.7%) และการให้บริการวิสัญญีแบบเฝ้าระวัง (16.5%) ส่วนการฉีดยาชาเฉพาะที่ทำเพียง 12% โดยเรียงตามลำดับดังนี้ การฉีดยาชาเฉพาะส่วนที่กลุ่มประสาทเบรเคียล(7.1%) การฉีดยาชาเข้า ไขสันหลัง (2.21%) และการฉีดยาชาที่ตำแหน่งประสาทส่วนปลาย (2.06%) propofolเป็นยาที่ใช้บ่อยที่สุดในการนำสลบ (46.3%) ส่วน penthotalใช้เพียง 2.35% ยาหย่อนกล้ามเนื้อใช้ succinylcholine สำหรับใส่ท่อช่วยหายใจ (8.8%) ส่วนยาหย่อนกล้ามเนื้อในกลุ่มnondepolarizing ที่ใช้บ่อยเรียงตามลำดับดังนี้คือ atracurium (5.1%), cisatracurium (3.3%) และ vecuronium (2.43%) ส่วนยาชานั้นใช้มากที่สุดคือ lidocaine (29.76%) สำหรับ bupivacaineใช้เพียง 7.9% ยาในกลุ่มอนุพันธ์ฝิ่นที่ใช้มากที่สุดคือ fentanyl (46.16%) ภาวะแทรกซ้อนที่พบบ่อยส่วนใหญ่เกี่ยวข้องกับระบบหายใจได้แก่ ภาวะอิ่มตัวของระดับออกซิเจนต่ำ (18:10,000) การใส่ท่อหายใจยาก (2.6:10,000) การใส่ท่อหายใจซ้ำ (2.6:10,000) ภาวะสำลักน้ำหรืออาหารเข้าปอด (2.6:10,000) วินิจฉัยว่าการใส่ท่อเข้าหลอดอาหารซ้ำ (1.3:10,000) ส่วนภาวะแทรกซ้อนอย่างอื่นได้แก่ ภาวะรู้ตัวระหว่างให้ยาสลบ (1.3:10,000) สงสัยเกิดภาวะกล้ามเนื้อหัวใจตายหรือ ขาดเลือด (1.3:10,000) การให้ยาผิด (1.3:10000) มีผู้ป่วยเข้าพำนักในโรงพยาบาลโดยไม่ได้คาดการณ์มาก่อน (6:10000) ไม่พบผู้ป่วยเกิดภาวะหัวใจหยุดเต้นหรือเสียชีวิตเลย
สรุป: ภาวะแทรกซ้อนทางวิสัญญีที่เกิดขึ้นในผู้ป่วยนอกมีอุบัติการณ์ต่ำเมื่อเทียบกับการเกิดอุบัติการณ์ทั่วไปในห้องผ่าตัด โดยส่วนใหญ่เกิดในระบบหายใจ การศึกษาครั้งนี้ยังไม่พบภาวะแทรกซ้อนที่เกิดจากการฉีดยาชาเฉพาะส่วน อย่างไรก็ตามแม้ว่าอุบัติการณ์ต่ำ บุคลากรที่ทำหน้าที่ให้ยาระงับความรู้สึกในผู้ป่วยนอกควรมีความรู้และทักษะในการเลือกและเตรียมผู้ป่วย ดังนั้นการประเมินผู้ป่วยก่อนเข้าห้องผ่าตัดจึงมีความสำคัญ