# Anesthesia-Related Complications of Caesarean Delivery in Thailand: 16,697 Cases from the Thai Anaesthesia Incidents Study

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***Background:*** *Maternal complications related to anesthesia are low in comparison with the results from obstetric factors in developing countries. The purposes of the present study were to determine the incidence of maternal mortality related to anesthesia, to analyze the causes and to suggest measures to improve anesthetic safety for the parturients.*
***Material and Method:*** *The present study was part of a multi-center study conducted by the Royal College of Anesthesiologists of Thailand aimed at surveillance of anesthesia-related complications in Thailand. The authors conducted a prospective survey of hospital records from all of the cases in and outside the operating room receiving general anesthesia in 18 centers between March 1, 2003 and February 28, 2004. All the forms were checked and verified by three-peer review then included in the analysis, using descriptive statistics.*
***Results:*** *Sixteen thousand six hundred ninety seven cases were included. The incidence of anesthetic complication in parturients was 35.9:10,000 (95% CI 27.4, 46.1). Incidence of the four most common anesthetic related adverse events in caesarean section were desaturation 13.8 (95% CI 8.7, 20.7), cardiac arrest 10.2 (95% CI 5.9, 16.3), awareness 6.6 (95% CI 3.3, 11.8), and death related anesthesia 4.8 (95% CI 2.17, 9.4). Of these, seven (17.5%) had preeclampsia/eclampsia and 46 (76.7%) presented for emergency caesarean delivery. General anesthesia was used in 41 patients (68.4%) and spinal in eighteen (30%). There were eight maternal deaths including five with general anesthesia, giving a case fatality rate of 0.1% of general anesthetics or 0.3% of caesarean deliveries.*
***Conclusion:*** *The authors found that inexperience, inadequate knowledge, inadequate care, and patient conditions were the major contributory factors. Most of them were preventable and correctable. Additional training and quality assurance can improve and prevent these serious adverse events.*

***Keywords:*** *Anesthesia, Complications, Caesarean delivery, Cause, Incidence*

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Maternal mortality is a major health problem in developing countries, accounting for over 98% of the global maternal deaths, and reductions in maternal mortality have been identified as a prominent component of United Nations Millennium Development Goals[1]. The World Health Organization estimates that 585,000 women die each year from pregnancy-related causes, and almost all of these deaths occur in this area. Significant reductions in maternal mortality began only in the late 19 century in Europe and North America, and in Thailand. The maternal mortality in Thailand was reported as 37.2 per 100,000 live births in 1987, but by 1998, it had declined to 7.0 per 100,000.

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The mortality rate increased to 12.3 in 1999 and continued to increase to 13.3 in 2004[2]. Studies on maternal mortality often implicate hemorrhage, sepsis, hypertensive diseases of pregnancy, and induced abortion complications as the major risk factors[3,4]. However, anesthesia is emerging as an additional risk factor of concern in studies of maternal deaths[5-7]. The number of case fatalities associated with anesthesia is small compared with those associated with obstetric factors, and these cases have been described as avoidable[8,9]. Anesthesia as a cause of maternal mortality is considered by some to be inexistant because it is largely underreported in the Third World[4,5]. Causes of maternal mortality in Thailand in 2000 include hemorrhage (37%), embolism (11.7%), hypertension (10%), infection (8.5%), and anesthesia (3.1%)[10].

To improve the quality of anesthesia care for obstetric patients, practitioners have begun to take every opportunity to identify and understand the risks incurred when providing obstetrical anesthesia. The objectives of the present study were to determine the incidence and risk factor of anesthetic complication in parturients, a potentially preventable adverse event. The authors analyzed our quality assurance database to identify the causes of complications.

## Material and Method

The Thai Anesthesia Incidents Study (THAI Study) is a multi-centered study including seven university hospitals, four tertiary care hospitals, four secondary care hospitals, and four district hospitals[11,12]. After the approval by the Institute Ethical Review Board, the present study monitored the incidence of anesthesia-related complication for caesarean delivery between March 1, 2003 and February 28, 2004. Details of pre-anesthetic conditions, anesthetic management, intra-operative events and peri-operative complications among consecutive patients within 24 hours of post-operative were recorded on standardized forms. The responsible anesthetist/nurse anesthetist asked four key questions, what is/ are adverse events, who, when, and how the event occurred? Each case was reviewed by the preliminary quality assurance (QA) committee, comprising three anesthetists from different university hospitals, to assess whether the inclusion criteria were met. The workshop and internal audit were performed during an extensive introductory phase to ascertain the standardization.

Contact was made with the anesthetist involved or the admitting hospital's anesthetic records reviewed. The QA committee participated in the peer review of the reported cases to reach a consensus of the type of error. The assumption underlying the authors' QA peer review process was that all adverse outcomes of caesarean delivery were the result of either 'human' or 'system' error.

Each incident form was reviewed and relevant factors entered into the SPSS program. Data were entered as originally recorded on the individual reports then analyzed. The demographic data included age, American Society of Anesthesiology physical status (ASA PS) and co-morbidities. The authors recorded the type of event, the type (s) of anesthetic used, and both the immediate and longer-term outcomes.

Risks were categorized into patient, anesthetic, surgical, and systemic factors. The patient-risk factors included pathology of each patient's disease, symptoms, and signs of complicated obstetrics. The anesthetic risk factors included anesthetic drugs and technique (s), and anesthesia personnel. The surgical risk factors included the type of surgery, emergency setting, and duration of surgery. The systematic risk factors included the level of hospital, occurrence place, and contributing factors.

### *Data collection and analysis*

The data from each hospital were keyed in at the data management center using a double entry technique to ensure the reliability of data entry. All statistical analyses were performed with SPSS version 11.5 (SPSS Inc, Chicago, IL). Descriptive statistics were used to calculate the occurrence of anesthesia-related complications.

## Results

In the database of 172,679 patients in the Thai Anesthesia Incidents Study (THAI Study), 16,697 parturients underwent caesarean section (9.7%). The incidence of adverse outcome was 35.9:10,000 (95% CI 27.4, 46.2), and maternal mortality rate was 4.8:10,000 (95% CI 2.1, 9.4). The incidents occurred in university hospitals (50. 6%), tertiary care hospitals (25.3%), and secondary care hospitals (24.1%). Patient characteristics are summarized in Table 1. Most cases of complicated caesarean delivery (55 cases, 91%) had ASA PS class 1 and 2, and they were mostly emergency cases (76.7% of all complicated C-section). The remaining five cases had ASA PS

**Table 1.** Demographic data

| | All C-section n (%) | Complicated C-section n (%) |
|---|---|---|
| ASA PS | | |
| 1 | 12,683 (76.0) | 29 (48.3) |
| 2 | 3,745 (22.4) | 26 (43.3) |
| 3 | 218 (1.3) | 3 (5.0) |
| 4 | 19 (0.1) | 2 (3.3) |
| Emergency cases | 5,760 (34.5) | 46 (76.7) |
| Non-office hour | 8,084 (48.4) | 33 (55.0) |
| Age: mean ± SD | 29.6 ± 6.5 | 29.4 ± 5.5 |
| Weight: mean ± SD | 67.0 ± 11.1 | 67.4 ± 11.1 |
| Height: mean ± SD | 156.1 ± 6.5 | 156.1 ± 5.1 |
| Anaesthetic duration(min): mean ± SD | 60.0 ± 24.9 | 79.7 ± 53.5 |
| Anaesthetic technique: | | |
| General anaesthesia(GA) | 4,677 (27.5) | 33 (55. 0) |
| Spinal anaesthesia (SB) | 11,310 (66.5) | 18 (30.0) |
| Epidural anaesthesia (EDB) | 669 (3.6) | 1 (1.7) |
| GA due to fail SB + EDB | 360 (2.1) | 8 (13.4) |
| Preoperative condition | | |
| Normal | 13,798 (82.6) | 31 (51.7) |
| Respiratory | 318 (1.9) | 5 (8.3) |
| Cardiovascular | 808 (4.8) | 11 (18.3) |
| Hematology / infection | 865 (5.2) | 7 (11.7) |
| Morbid obesity | 286 (1.7) | 5 (8.9) |
| Neuro-muscular | 67 (0.4) | 1 (1.7) |
| Endocrine / metabolic | 493 (3.0) | 1 (1.7) |
| Other | 62 (0. 4) | 4 (6.7) |
| Sites | Cardiac arrest (%) | Death (%) |
| University hospitals | 41.2 | 25 |
| Tertiary (regional) hospitals | 17.6 | 25 |
| Secondary hospitals | 41.2 | 50 |

class 3 and 4 (5 cases). Thirteen in 17 cases of cardiac arrest had ASA PS class 1, 2. Six (50%) cases were from secondary care hospital (Table 1). The causes of death in the present study included inappropriate ACLS, coagulopathy from prolonged shock, the lack of ECG monitoring, and the absence of an anesthesiologist, post severe traumatic injury, and failed intubation at ward by the obstetrician. The most frequent indication for surgery were abnormal presentation (12.3%), pregnancy-induced hypertension, fetal distress, cephalopelvic disproportion (12% in each), and placenta previa (10.0%). The two serious (cardiac arrest and death) complications occurred in the emergency period, and four cases had no underlying disease. The morbid obesity parturients (2 in 5 cases) had cardiac arrest. There were 41 (68.4%) of complicated caesarean delivery developed under general anesthetic technique. Parturients with cardiac arrest (53%) and death (62, 5%) developed under general anesthetic. Only three (37.5%) death and eight (47%) cardiac arrest developed under spinal anesthesia. Seventy-five percent of death developed in tertiary and secondary hospitals (Table 1).

The three most frequent involved anesthetic personnel in the present study were nurse anesthetists (77.8%), anesthetists (76.6%), and trainee anesthetists (39.5%). In general, hospitals where there was no anesthesiologist (23.4%), surgeons or obstetricians administered anesthesia by themselves (13.2%). Nurse anesthetists had prime action in 50% of dead parturients.

Table 2 shows time of occurrence, of which the majority of adverse events occurred in the intraoperative period (69.5%), and mostly categorized in level one of anesthetic related or totally related to adverse outcomes. Contributing factors for complicated parturients were related to anesthetic techniques (51.8%), cofactors (37.5%), and patient condition

(10.7%). Five in nine cases of cardiac arrest occurred in the maintenance period. Adverse outcomes were documented to be preventable in 60% of patients, partially preventable in 32.7%, and unpreventable in 7.3%.

Incidence (n per 10,000) of the four most common anesthesia related adverse events in caesarean delivery were desaturation 13.8 (95% CI 8.7, 20.7), cardiac arrest 10.2 (95% CI 5.9, 16.3), awareness 6.6 (95% CI 3.3, 11.8), and death related to anesthesia 4.8 (95% 2.1, 9.4) (Table 3). In the present study the authors excluded personal hazard and unplanned hospital admission. There was no evidence of transfusion mismatch, suspected myocardial ischemia, and malignant hyperthermia from the present study. Airway related complication such as difficult intubation, re-intubation, esophageal intubation, fail intubation, and pulmonary aspiration were found in 15 cases (25%). Two cases of total spinal blocks were performed by surgeons. These two patients eventually died in the intensive care unit.

**Table 2.** Place and period of occurrence, level of anaesthetic attribute to event, and preventability

| | n | % |
|---|---|---|
| Place and period of adverse event (n = 59) | | |
| Induction | 1 | 1.7 |
| Intubation | 16 | 27.1 |
| Maintenance | 20 | 33.9 |
| Emergence | 4 | 6.8 |
| Postanaesthetic care unit (PACU) | 8 | 13.6 |
| Ward 24-hr postoperative | 10 | 16.9 |
| Preventability (n = 55) | | |
| Preventable | 33 | 60.0 |
| Partial preventable | 18 | 32.7 |
| Unpreventable | 4 | 7.3 |

Preoperative risk conditions were normal condition (51.7%), airway problems (14.13%), and morbid obesity (8.9%). Anesthesia was considered to be the sole contribution factor in 82.1% of patients, complicated obstetrics (20%), and surgical attribute to complication (7.3%).

Within 24 hours following adverse outcomes, twenty-six parturients (46.5%) had transient physiologic change (minor and major), cardiac arrest (19.6%), and death (11.7%). Twenty-four hours after the events, 39 (70.9%) parturients had complete recovery while death ensued in five cases (9.1%), and there were two cases of brain death (3.6%) (Table 4).

Events management was evaluated. Thirty-four (61.8%) parturients were adequately treated, 10 (18.2%) were inadequately treated but not hazardously,

**Table 3.** Order of frequency of anaesthetic-related adverse events in caesarean section stratified by 4 periods: intraoperative, PACU, postoperative 24 hr, and intensive care unit

| Adverse events | Intraoperative n (%) | PACU n (%) | Postoperative 24 hr n (%) | ICU n (%) | Total events n (%) | n per 10,000 (95% CI) |
|---|---|---|---|---|---|---|
| Desaturation | 19 (35.2) | 4 (30.8) | 0 | 0 | 23 (38.1) | 13.8 (8.7, 20.7) |
| Cardiac arrest | 11 (20.4) | 4 (30.8) | 1 (5.6) | 1 (50) | 17 (28.3) | 10.2 (5.9, 16.3) |
| Awareness | 0 | 0 | 11 (61.1) | 0 | 11 (18.3) | 6.6 (3.3, 11.8) |
| Death related to anaesthesia | 5 (9.3) | 1 (7.7) | 1 (5.6) | 1 (50) | 8 (13.3) | 4.8 (2.1, 9.4) |
| Difficult intubation | 6 (11.1) | 0 | 0 | 0 | 6 (10) | 3.6 (1.3, 7.8) |
| Anaphylaxis | 2 (3.7) | 0 | 2 (11.1) | 0 | 4 (6.7) | 2.4 (0.7, 6.1) |
| Unplanned ICU admission | 2 (3.7) | 0 | 1 (5.6) | 0 | 3 (5) | 1.8 (0.4, 5.3) |
| Re-intubation | 0 | 3 (23.1) | 0 | | 3 (5) | 1.8 (0.4, 5.3) |
| Pulmonary aspiration | 3 (5.6) | 0 | 0 | 0 | 3 (5) | 1.8 (0.4, 5.3) |
| Nerve injuries | 0 | 0 | 2 (11.1) | 0 | 2 (3.3) | 1.2 (0.2, 4.3) |
| Failed intubation | 2 (3.7) | 0 | 0 | | 2 (3.3) | 1.2 (0.2, 4.3) |
| Coma / CVA / convulsion | 1 (1.9) | 1 (7.7) | 0 | 0 | 2 (3.3) | 1.2 (0.2, 4.3) |
| Total spinal block | 1 (1.9) | 0 | 0 | 0 | 1 (1.7) | 0.6 (0.02, 3.3) |
| Esophageal intubation | 1 (1.9) | 0 | 0 | | 1 (1.7) | 0.6 (0.02, 3.3) |
| Drug error | 1 (1.9) | 0 | 0 | 0 | 1 (1.7) | 0.6 (0.02, 3.3) |
| Total 60 case | 54 (100) | 13 (100) | 18 (100) | 2 (100) | 87 (100) | 52.1 (41.8, 64.2) |

Some patients had at least 1 adverse event
PACU = postanaesthetic care unit; ICU = intensive care unit; CVA= cerebrovascular accident

**Table 4.** Outcome of management

| | n | % |
|---|---|---|
| Immediate outcome (within 24 hr)* | | |
| Complete recovery | 12 | 21.5 |
| Minor transient physiologic change | 10 | 17.9 |
| Major transient physiologic change | 16 | 28.6 |
| Cardiac arrest | 11 | 19.6 |
| Death | 7 | 11.7 |
| Long term outcome (> 24 hr to 7 days post-operative)* | | |
| Complete recovery | 39 | 70.9 |
| Prolong respiratory support | 4 | 7.3 |
| Vegetative / brain death | 2 | 3.6 |
| Death | 5 | 9.1 |
| Other | 5 | 9.1 |

* Missing 4 cases

**Table 5.** Contributing factors and suggestive corrective strategies (n = 60)

| Contributing factors | n | % |
|---|---|---|
| Human factors | | |
| Inadequate decision | 6 | 10.9 |
| Inadequate knowledge | 12 | 21.8 |
| Inexperience | 32 | 58.2 |
| Hesitate | 2 | 3.6 |
| Inadequate care | 7 | 12.7 |
| Facility failure | | |
| Lack of supervision | 1 | 1.8 |
| Communication failure | 5 | 9.1 |
| Medical failure | 6 | 10.9 |
| Equipment: absent | 2 | 3.6 |
| Equipment: malfunction / fail | 1 | 1.8 |
| Postanaesthetic care unit care failure | 1 | 1.8 |
| Intensive care unit care failure | 2 | 3.6 |
| Patient condition | 7 | 12.7 |
| Other | 3 | 5.5 |
| Suggested corrective strategies | | |
| Additional training | 33 | 60.0 |
| Quality assurance activity | 13 | 23.6 |
| Guideline practice | 11 | 20.0 |
| Improve communication | 6 | 10.9 |
| Improve supervision | 6 | 8.3 |
| More manpower | 1 | 1.8 |
| More equipment provide | 1 | 1.8 |

and four (12.8%) cases received inadequate treatment, which resulted in hazardous outcome.

For system analysis, the authors found three most important contributing factors which included inexperience (58.2%), inadequate knowledge (21.8%), and poor patient conditions (12.7%). The majority of reports suggested corrective strategies that included additional training 33 (60%) and quality assurance activity 13 (23.6%) (Table 5).

## Discussion

Sixteen thousand six hundred ninety seven caesarean deliveries during the present study period were analyzed. Regional analgesia was the predominant method and accounted for 11,979 (70.1%) of the anesthetic techniques. General anesthesia was performed in 5,037 (29.6%). The frequency of procedure-related complications is shown in the Table 1.

The pre-anesthesia care for the maternal patient is often limited due to the emergent nature of the obstetric event as revealed in the present study that more emergency cases were found in the complicated caesarean section.

The caesarean section rate among all mothers during the one year of the present study was 24.6%. The three most common anesthesia-related complications in the present study were desaturation, cardiac arrest, and awareness. Desaturation is measured by pulse oximetry and defined as a fall of oxygen saturation to lower than 90% for at least three minutes or saturation of 85% and lower. However, the availability of pulse oximetry in Thailand only limits to secondary, tertiary, and university hospitals. Most district hospitals have only noninvasive blood pressure monitoring, and electrocardiography. Cause of desaturation is primarily due to reduced functional residual capacity of pregnant patients thereby reducing oxygen reserve on pre-oxygenation. In addition, an increased basal metabolic rate in a mother makes hypoxia develops faster. Furthermore, the limited availability of airway rescue tools, such as LMA, fiberoptics only in secondary, tertiary, and university hospitals may aggravate the severity of the ventilation problem. Cardiac arrest is defined as the cessation of mechanical activity, as confirmed by the absence of signs of circulation. Cardiac arrest in the present study was associated with hemodynamic cause and underlying complicated pregnancy (50%). The detection of awareness is determined during the postoperative interview 24 hour after the surgery by the trained nurse anesthetist. If the awareness was suspected, the interviewer then reported to the nurse anesthetist or an anesthesiologist who gave anesthesia to the patient to verify the presence of intraoperative awareness using five recommended key questions. Awareness incident was 0.08% of all

patients during the study period, 14.14% of this group are parturients[13]. The associated factors for those obstetric cases with ASA physical status I and II who experienced awareness were non-premedication, inadequate doses of sedation after cord clamping, and intraoperative use of neuromuscular blocking agents. The usual general anaesthetic regimen in the present study included induction agents of sodium thiopentone, propofol, or ketamine and intubation with either succinylcholine (1.5 mg/kg) or other non-depolarizing muscle relaxants. The general anesthesia was maintained with $N_2O$, $O_2$, and halothane, isoflurane, or sevoflurane. The sedation after cord clamping was given by either the use of midazolam or diazepam. For parturients with ASA physical status more than 2, there was the associated factor of massive hemorrhage leading to hemodynamic instability that limited the use of appropriate dose of sedatives and inhalation during the operation.

The reasons for the high maternal mortality ratio in tertiary (50%) and secondary hospitals (25%) are obvious. Most of the referred patients were quite moribund by the time they arrived at the university hospital. These deaths highlight examples of the following aspects of care and include inexperience (58%), inadequate knowledge (23%), lack of appreciation of the severity of the illness (13%), lack of multidisciplinary cooperation, lack of peri-operative care, and the inappropriate management of hemorrhage. At present, there are many hospitals in Thailand where anesthesia is performed by surgeons or obstetricians due to the small number of anesthesiologists for the overall Thai population. The Royal College of Thai Anesthesiologists with the collaboration of the Ministry of Public Health initiated the 1-year training program of nurse anesthetists, more than twenty years ago, to alleviate the problem. A nurse anesthetist receives a certificate of training after completion of the program and works under the supervision of either an anesthesiologist or a surgeon. Data from the THAI study revealed that general anesthesia was mainly administered by nurse anesthetists (34.1%), followed by anesthesia residents (28.5%), nurse, anesthetist trainee (17.6%), anesthesiologists (15.7%), and surgeons (0.45%). In university hospitals, attending anesthesiologists supervise the residents and trainees, but in most district hospitals, the surgeons supervise nurse anesthetists giving general anesthesia. In case of spinal anesthesia, the surgeons administer it by themselves if there is no anesthesiologist in the hospital. In Thailand, the Royal College of Anesthesiologists of Thailand does not allow nurse anesthetists to perform spinal anesthesia.

Because death due to anesthesia is the sixth leading cause of pregnancy-related mortality in the United States[14]. Hawkins et al characterized the obstetric anesthesia deaths in the United States by specific cause, the relationships of these deaths to the type of anesthetic, and the type of obstetric procedure for the time period 1979 to 1990[15]. Those correspond with the present study. The present study showed that anesthesia was the cause of mortality in eight mothers. Most women were undergoing general anesthesia for caesarean delivery, case fatalities following 36% related to complicated obstetrics (unstable haemodynamic from hemorrhage). Although maternal morbidity and mortality associated with anesthesia are yet to be eliminated, their incidence has been on the decline in reports from developing countries[2,16,17,18]. Maternal safety may be linked to policy changes in the training of specialist anesthetists and the development of guidelines for obstetric anesthesia[19].

The study of Enohumah from Nigeria showed that difficulty with airway management was seen in 67% of the maternal deaths[20], in contrast with the present THAI study, the authors had 25% of airway problems and no serious complications. However, airway management has remained the major risk factor in anesthesia-related maternal morbidity in THAI study. This has led to concerns with the use of general anesthesia for caesarean section[21], especially if alternative anesthetic techniques are applicable. The arguments on both sides are strong and valid. A well-conducted anesthetic for caesarean delivery continues to be the primary focus. However, available data shows a shift from general anesthesia to regional anesthesia for caesarean section[18,20-23]. General anesthesia is often the choice when there are limitations (*i.e.* no anesthetists) or contraindications to the use of a regional technique. Thus, it is likely to be the preferred technique for patients with severe coexisting morbidities. Nevertheless, the fatalities in the present study occurred in a healthy population of patients. It can be speculated, therefore, that spinal anesthesia could have achieved a better outcome.

Obese pregnant women (body mass index, BMI, greater than 35) are at greater risk from anesthesia[24] and should be referred to the anesthetist early. Adequate advanced consultation of high-risk cases must be given to the obstetric anesthesia service. The notification must be early enough to allow specialist advice, additional investigation, and

assembly of resources needed for the safe management of high-risk women[25].

The isolation of relatively inexperienced trainee anesthetists (58.2%) was considered to be a factor in all of these cases. It was not possible to receive urgent experienced help that might have been able to recognize and correct the misplaced tracheal tubes. Even with experienced anesthetists, when unexpected difficulties occur, the availability of a second pair of hands may be life saving, in addition to the good monitoring such as end-tidal carbon dioxide.

Although there is no substitute for the presence of a vigilant anesthesiologist, monitoring in the peri-operative period should be optimal. The availability of relevant monitors, such as a pulse oximeter and capnography, could have prevented some of the observed catastrophes. For instance, at the induction of anesthesia, drug-induced apnea coupled with ventilatory changes in the parturient may be a risk, irrespective of vigilance. At this period in particular, the borders between adequate oxygenation and hypoxemia are less distinct and surrogate clinical parameters may not be reliable. Thus, the procedure of laryngoscopy and tracheal intubation present great potential danger to the patient in the absence of appropriate monitors. Anesthesia training must ensure competence in airway management, especially the recognition and management of esophageal intubation. It is necessary to enforce a minimal level of training and experience of the anesthetist providing anesthesia for caesarean section. Similarly, the organization of obstetric anesthesia services is vital to a good outcome. The young trainee anesthesiologist and nurse anesthetist should not provide anesthesia for surgical delivery alone, irrespective of the circumstance. A comparison of anesthesia-related maternal deaths in two hospitals in the UK showed that the level of anesthesia personnel was a major determinant of outcome in obstetric anesthesia[26]. The recommended staff requirements may be unattainable in developing countries at present because of difficulties with anesthesia manpower development[27]. However, organization of the limited human resources could help to minimize anesthesia related morbidity and mortality in developing countries. The department of anesthesiology in collaboration with the hospital could formulate policy prioritizing obstetric anesthesia services. Substandard care, lack of communication, and non-availability of skilled staff, which remains paramount contributors to maternal mortality in the UK[28], may be instructive to developing countries. The anesthetic and obstetric teams should ensure that the parturient and the unborn child receive the best care attainable in the hospital.

Worldwide, there are very few anesthesiologists available in rural settings. In Thailand, most rural districts have only 1-3 nurse anesthetists. Relatively few positions are available for post-graduate training in anesthesia, and the majority of anesthesiologists prefers working in urban areas, some in private practice, or goes abroad where the earnings are higher and living or working conditions are better. The impact of this registry in the Thai Anesthesia Incidents Study (THAI study) are as follows: 1) Policy-maker in the Ministry of Public Health should agreed to increase the position of anesthesiologists in Thai public hospitals 2) The Royal College of Anesthesiologists of Thailand (RCAT) recommended the pulse oximeter to be mandatory intraoperative monitoring in every patient receiving anesthesia instead of the optional monitoring 3) The RCAT issued the clinical practice guidelines for spinal anaesthesia and held academic activities regarding peri-anesthetic care after spinal anesthesia for Thai anesthesia personnel.

The present study has some limitations. First, the data presented are not truly representative of local or national incidence. It is probable that there has been an underestimation of anesthesia-related mortality. These target study centers, being a university, tertiary, and secondary hospital, have better anesthetic services than some regional or district hospitals. Second, the authors consider the complication rates that are found in the authors' material to be minimum estimates because only short-term (7 days) complications were recorded. Likewise, the incidence of awareness may be underestimated since the structured interview was performed only after one day postoperatively. Complications that occurred after discharge from hospital or in later pregnancies are not accounted for in the present study. Direct comparison of the complication rates that were observed in the present and other studies is difficult because of the variation in study design and definitions. Notwithstanding these limitations, the present study provides some insight into the probable anesthetic risk factors that may contribute to anesthesia-related maternal mortality in developing countries.

**Conclusion**

There are clearly needs to improve airway training, the level of experience of frontline anaesthesia

personnel and the immediate availability of skilled personnel backup. It has also been suggested that there is now a need for a guideline and protocol-driven care for obstetric anesthesia.

The magnitude of the anesthesia-related maternal mortality problem is grossly understated. Multiple sources of information must be used to identify pregnancy-associated deaths, to determine which are pregnancy-related, and to understand the contributing risk factors. General anesthesia, difficult airway management, inexperience, inadequate knowledge, and inadequate care were the major anesthetic risk factors in the present study. The duty of providing anesthesia for the obstetric patient should be performed only by those with the requisite training. Anesthetist trainees (both doctors and nurses) must be given adequate coverage and good quality assurance activity so as to achieve a better outcome for the mother and baby.

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# การศึกษาผลของการผ่าตัดคลอดทารกโดยการให้ยาระงับความรู้สึกในประเทศไทย

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***วัตถุประสงค์:*** *เพื่อศึกษาอัตราการเกิดอุบัติการณ์และปัจจัยที่เกี่ยวกับภาวะแทรกซ้อนจากการให้ยาระงับความรู้สึกในผู้ป่วยสูติกรรม*

***รูปแบบการศึกษา:*** *เชิงพรรณนา*

***วัสดุและวิธีการ:*** *การศึกษานี้เป็นส่วนหนึ่งของการเฝ้าระวังภาวะแทรกซ้อนทางวิสัญญีในผู้ป่วยทุกราย ที่ได้รับการให้ยาระงับความรู้สึกของราชวิทยาลัยวิสัญญีแพทย์แห่งประเทศไทย เพื่อตรวจหาภาวะแทรกซ้อนทางวิสัญญีวิทยาในประเทศไทย การศึกษานี้ทำการรวบรวมข้อมูลเฉพาะผู้ป่วยสูติกรรมตั้งแต่ 1 กุมภาพันธ์ พ.ศ. 2546 ถึง 31 มกราคม พ.ศ. 2547 เมื่อเกิดภาวะแทรกซ้อนจากการให้ยาระงับความรู้สึกในผู้ป่วยสูติกรรม จะทำการบันทึกข้อมูลในแบบบันทึกข้อมูล โดยจะบันทึกข้อมูลเกี่ยวกับสาเหตุ ปัจจัยที่เกี่ยวข้อง และแนวทางแก้ไขตามแบบบันทึกข้อมูล จากนั้นนำข้อมูลไปวิเคราะห์ทางสถิติเชิงพรรณนา*

***ผลการศึกษา:*** *ผู้ป่วยที่ได้รับการให้ยาระงับความรู้สึกทั้งสิ้น 172,700 ราย ที่เข้าโครงการการเฝ้าระวังภาวะแทรกซ้อนทางวิสัญญีในประเทศไทย เป็นผู้ป่วยสูติกรรมที่มารับการให้ยาระงับความรู้สึก 16,697 ราย คิดเป็นร้อยละ 9.7 พบอุบัติการณ์ภาวะแทรกซ้อนจากการให้ยาระงับความรู้สึกทั้งสิ้น 65 ราย คิดเป็น 35.9 ต่อผู้ป่วย 10,000 ราย (95% CI 27.4, 46.1) มีอายุเฉลี่ย 29.4 $\pm$ 5.5 ปี ภาวะแทรกซ้อนที่พบมากสุดคือภาวะ Desaturation 13.8 (95% C8.7, 20.7) รองลงมาคือ cardiac arrest 10.2 (95% CI 5.9, 16.3), awareness 6.6 (95% CI 3.3, 11.8), และ death related anesthesia 4.8 (95% CI 2.17, 9.4) เทคนิคการให้ยาระงับความรู้สึก ที่ทำให้เกิดส่วนใหญ่ คือ การระงับความรู้สึกแบบทั่วตัว (ร้อยละ 68.4) รวมทั้งมีมารดาที่เสียชีวิต 5 ใน 8 ราย ทำให้มีอุบัติการณ์การเสียชีวิตของมารดาจากการระงับความรู้สึกแบบทั่วตัวร้อยละ 0.1 และร้อยละ 0.3 ของการผ่าตัดคลอด*

***สรุป:*** *ภาวะแทรกซ้อนจากการให้ยาระงับความรู้สึกในผู้ป่วยสูติกรรมในประเทศไทย มีสาเหตุเกิดจากการขาดประสบการณ์ ความรู้ไม่พอเพียง และไม่ได้มาตรฐานการดูแล ซึ่งแนวทางการป้องกันที่เหมาะสม คือ การพัฒนาบุคลากรในเรื่องความรู้ ความสามารถ การจัดกิจกรรมประกันคุณภาพการบริการ และมีแนวทางในการปฏิบัติงาน*