Original Article

Cardiac Arrest and Complications after Spinal Anesthesia: The Perioperative and Anesthetic Adverse Event in Thailand (PAAd Thai) Incident Report Study

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Background: Spinal anesthesia is one of most common anesthetic techniques in Thailand. The Perioperative and Anesthetic Adverse Events in Thailand (PAAd Thai) Study was a multicentered project among 22 hospitals across the country to investigate the incidence of anesthesia related complications.

Objective: To study the incidences of cardiac arrest and complication after spinal anesthesia including the contributing factors and suggested corrective strategies.

Materials and Methods: This prospective descriptive study of the incident reports that occurred regarding spinal anesthesia collected from 22 participating hospital in the data collection between January and December of 2015 was completed. Three senior anesthesiologists reviewed the data and descriptive statistics were used.

Results: Among 62,120 spinal anesthesia, there were 127 incidents (5.8%) among 2,206 incident reports related to anesthesia. There were seven cases of intraoperative cardiac arrest with an incidence of 1.13:10,000 spinal anesthesia (95% CI 0.55 to 2.33). Other complications were bradycardia with less than 40 beats per minute (50.4%), anaphylaxis or anaphylactoid reaction or drug allergy (14.2%), drug error (8.4%), coma or CVA or convulsion (3.9%), and suspected pulmonary embolism (3.9%). Adverse events occurred frequently with specialties or surgeries of orthopedics (44.1%), cesarean delivery (17.3%), urosurgery (17.3%), general surgery (14.2%), and gynecological surgery (4.7%), respectively.

Conclusion: Contributing factors were inexperience, inappropriate decision making, haste, and inappropriate pre-anesthetic evaluation or preparation while factors minimizing incidents were vigilance, having experience, and experienced assistants. Suggested corrective strategies were quality assurance activity, guidelines especially monitoring, improvement of supervision, and additional training.

Keywords: Spinal anesthesia, Adverse events, Incidents, Complications, Neuraxial anesthesia, Cardiac arrest

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Spinal anesthesia is one of the most common and widely used anesthetic procedures. It is a safe, cost-effective, and efficient technique of neuraxial anesthesia for the surgical site below the diaphragm[1-3]. It provides intense motor, sensory, and sympathetic blockage with small dose of local anesthetic agent[1].The advantage of spinal anesthesia is no airway instrumentation, profound analgesia, stable hemodynamics, less surgical blood loss, and improved operating conditions[1-3]. Due to the invasive nature of spinal anesthesia, there are reported disadvantages that include the physiological complications due to neurological blockage with local anesthetic agent, which include bradycardia, heart block, and cardiac arrest[1-3]. The common complications such as bradycardia or hypotension may induced serious complications such as total spinal block and cardiac arrest[1-3]. Fortunately, more

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severe neurological complications such as death, neuropathy, arachnoiditis, and permanent neurologic injury are rare[3]. Many of these complications can be reduced with meticulous attention to details during the performance of the spinal block by selecting the appropriate technique, drugs, and their doses[1,3]. According to the Thai Anesthesia Incidents Monitoring Study in 2008, most incidents (74.4%) were bradycardia with a heart rate of less than 50 beats per minute, hypotension (18.6%), and respiratory complication (5.4%)[4]. The impact of spinal anesthesia technique on perioperative outcomes and adverse events in Thailand need to be explained to understand the overall picture.

The Royal College of Anesthesiologists of Thailand (RCAT) has initiated knowledge, practice guideline, and training program to improve anesthetic management and outcomes. Therefore, the RCAT initiated the Perioperative Anesthetic Adverse Events in Thailand (PAAd Thai) study to investigate the incidences of perioperative and anesthesia adverse events, contributing factors, factors minimizing outcomes, and suggested corrective strategies for adverse events regarding anesthesia. The present study was a part of the PAAd Thai study to identify complications in spinal anesthesia and highlight the contributing factors and factors minimizing incidents to prevent such complications.

Materials and Methods

A multicenter observational study was prospectively conducted as a part of the PAAd Thai study, by the RCAT between January 1 and December 31, 2015. All anesthesiologists and nurse anesthetists in 22 participating hospitals across Thailand were asked to report critical incidents on voluntary and anonymous basis. The present study was approved by each institutional ethics committee, the requirement for informed consent from patients was waived by the Institutional Review Board (IRB No. 522/57). Identification of the patient and all names of medical or surgical care providers were kept confidential. The demographic patient data and adverse events of spinal anesthesia were recorded in standard incident report form comprising of standardized questionnaire and narrative part. These included anesthesia profile, surgery profile, operative site, perioperative period of the incident, adverse events, contributing factors, factors minimizing outcomes, and suggestive strategies for specific adverse events. The present study also recorded immediate outcome within 24 hours and long-term outcome at seven days. All incident record forms were verified by site manager. Three senior anesthesiologists analyzed the data. Any discrepancy was discussed to reach a consensus.

Statistical analysis

The descriptive statistics were used to summarize the data using IBM SPSS Statistics for Windows, version 22.0 (IBM Corp., Armonk, NY, USA).

Results

Out of 333,219 cases, 62,101 patients underwent spinal anesthesia with 131 incident reports regarding spinal anesthesia for surgery in 22 participating hospitals. There were four incident reports excluded from the present study because of irrelevant data according to the definition of adverse events and choice of anesthesia. Therefore 127 incident reports (5.8% of 2,206 cases) were analyzed. The patient, administrative, surgical, anesthetic data, and adverse outcomes of interest are given in Table 1. Monitoring during spinal anesthesia were non-invasive blood pressure (NIBP), mean arterial pressure, pulse oximeter, electrocardiography, and central venous pressure in 125 (98.4%), 8 (6.3%), 126 (99.2%), 126 (99.2%), and 4 (3.1%) cases, respectively. Four cases (3.2%) were changed to general anesthesia due to fail or inadequate analgesia, and five cases (3.9%) needed general anesthesia due to anesthesia worn off before the end of surgery.

Among 127 incident reports regarding spinal anesthesia in the database, 11 cases had cardiac arrest, comprising of seven cases (5.5%) of intraoperative cardiac arrest and four cases of cardiac arrest within 24 hours. Details of intraoperative cardiac arrest cases and their outcomes are shown in Table 2. Among other incident reports of cardiac arrest within 24 hours, three cases were orthopedic surgery, and one case was genitourinary cancer with post transurethral resection bleeding, all fatal outcomes were within seven days. Three out of four cases (75%) were patients aged more than 80 years old. One case developed cardiac arrest within 24 hours in ward, the spinal anesthesia was done by the surgeon.

The most frequent adverse events after spinal anesthesia in the present study was bradycardia with 40 beats or less per minute, which occurred in 28 orthopedic surgery (43.8%), 16 in general surgery (25.0%), 13 in genitourinary surgery (20.3%), six in Cesarean delivery (9.3%), and three in gynecological surgery (4.7%). Among all 64 bradycardia, which had 40 beats or less per minute, there were 37 (57.8%) minor physiologic changes, six major physiologic

Table 1. Demographic, administrative, surgical, anesthesia data, and adverse events (n=127)

	n (%)
Sex	
Male	70 (55.1)
Female	57 (44.9)
ASA PS	
1	34 (26.8)
2	63 (49.6)
3	29 (22.8)
4	1 (0.8)
Emergency	27 (21.3)
Time of anesthesia	
Working hour	100 (78.7)
On duty	27 (21.3)
Age	
11 to 20	10 (7.9)
21 to 30	12 (9.4)
31 to 40	25 (19.7)
41 to 50	16 (12.6)
51 to 60	10 (7.9)
61 to 70	23 (18.1)
71 to 80	20 (15.7)
≥81	11 (8.7)
Type of surgery	
Orthopedics	56 (44.1)
Cesarean delivery	22 (17.3)
Urosurgery	22 (17.3)
General	18 (14.2)
Gynecological	6 (4.7)
Other	3 (2.4)

Period of events	1; n (%)	2; n (%)	3; n (%)	All; n (%)
Bradycardia <40 beats/minute	64 (50.4)	-	-	64 (50.4)
Cardiac arrest	7 (5.5)	0 (0.0)	4 (3.1)	11 (8.6)
Anaphylaxis/anaphylactoid reaction/drug allergy	15 (11.8)	3 (2.4)	0 (0.0)	18 (14.2)
Medication error	11 (8.7)	-	-	11 (8.7)
Peripheral nerve injury	-	-	7 (5.5)	7 (5.5)
Severe arrhythmia	4 (3.1)	-	-	4 (3.1)
Coma/Cerebrovascular accident/ Convulsion	3 (2.4)	1 (0.8)	1 (0.8)	5 (3.9)
Suspected pulmonary embolism	3 (2.4)	1 (0.8)	1 (0.8)	5 (3.9)
Suspected myocardial ischemia/ infarction	1 (0.8)	0 (0.0)	1 (0.8)	2 (1.6)
Oxygen desaturation	1 (0.8)	2 (1.6)	-	3 (2.4)
Pulmonary aspiration	1 (0.8)	0 (0.0)	0 (0.0)	1 (0.8)

ASA=American Society of Anesthesiologists; PS=physical status

1=intraoperative, 2=recovery room, 3=within 24 hours

Data are not mutually exclusive

changes such as respiratory and cardiovascular events, while 56 patients (87.5%) gained complete recovery. There was one fatal case (1.6%). There were also four severe arrhythmia such as frequent premature ventricular arrhythmia, atrial fibrillation with rapid ventricular response, and supraventricular arrhythmia.

Among five cases of suspected pulmonary embolism (PE), three cases occurred intraoperatively with intraoperative cardiac arrest necessitated cardiopulmonary resuscitation. Of those three cases, one case was because of air embolism due to using of pressure bag on intravenous [IV] fluid and two cases of fixation of femur. One case was suspected in recovery room and transferred to the intensive care unit. Another case developed cardiac arrest in ward with diagnosis of suspected PE with fatal outcome. Four out of the five (80%) of suspected PE were orthopedic elderly patients and two cases (40%) developed fatal outcome.

There were 18 incident reports regarding anaphylactoid reaction, anaphylaxis, or drug allergy. There was only one patient with allergic history of penicillin who developed skin rash after administration of clindamycin IV infusion. The other related antibiotics were cephalosporin with five incidents (27.7%), ampicillin with one incident (5.5%), and cloxacillin with one incident (5.5%). There were three incidents (16.6%) regarding IV infusion such as gelofusine (gelatin) with two incidents (11.1%) and haemaccel with one incident (5.5%). There were three patients (16.6%) treated with pethidine (or meperidine) for antishivering effects who developed skin rash. The urticaria resolved with administration of antihistamine. One orthopedic patient developed hypotension, urticaria, and coughing, treated with antihistamine, dexamethasone, and vasopressor, and was admitted to the intensive care unit. Other cases were one incident of skin rash after IV administration of ketorolac, and two incidents of urticaria after blood transfusion. Out of 18 incidents there were 16 (88.8%) skin manifestation, nine (50.0%) hypotension, three (16.6%) respiratory symptom, and four (22.2%) gastrointestinal symptom such as nausea or vomiting. Sixteen patients developed mild allergic symptom, while two patients (11.1%) developed anaphylaxis or anaphylactoid reaction. Most of the patients recovered by conservative treatment with chlorpheniramine, dexamethasone, and observation in the post-anesthesia care unit. One patient needed intensive care unit admission and one case needed postponement of surgery. After review, the factors related to incidents were patient factors in 16 cases

Table 2. Details of case with intraoperative cardiac arrest after spinal anesthesia (n=7)

Age (year)/ sex	ASA PS	Surgery	Preoperative condition	Spinal anesthesia dose	Highest dermatome level	CPR	Outcome
31/F	III	Cesarean delivery	Acute coronary syndrome Acute fatty liver	Bupivacaine 12 mg (5)	T6	Yes/yes/no	Death within 24 hours
34/F	II	Cesarean delivery	Suspected Bart's hydrop fetalis Unconscious; pulseless	Bupivacaine 10 mg (2)	T4	Yes/no/no	Survived (full recovery)
80/M	III	Cementing Austin Moore hemiarthroplasty	Aging, HT Chronic kidney disease	Bupivacaine 15 mg (65)	T10	Yes/yes/no	Death on day 5
87/F	III	ORIF prosthetic hip hemiarthroplasty	Aging, HT	Bupivacaine 12.5 mg (20)	T8	Yes/no/no	Survived
69/M	II	Debridement tibia	Hypovolemia IV leakage	Bupivacaine 12.5 mg (10)	T10	Yes/no/no	Survived
74/F	III	Cementing Austin Moore hemiarthroplasty	Aging Echo (PE)	Bupivacaine 9 mg (75)	T6	Yes/yes/no	ROSC refer
87/M	III	ORIF with nailing femur	Aging, COPD Echo (PE)	Bupivacaine 17 mg (10)	T10	Yes/yes/yes	Vegetative

F=female; M=male; ASA=American Society of Anesthesiologists; PS=physical status; ORIF=open reduction and internal fixation; HT=hypertension; IV=intravenous; Echo=echocardiography; PE=pulmonary embolism; COPD=chronic obstructive pulmonary disease; CPR=cardiopulmonary resuscitation; ROSC=return of spontaneous circulation

(88.9%) and anesthesia factors in four cases (22.2%), and one patient (5.5%) related to surgical factor such as cementing with methylmethacrylate.

There were 11 incident reports of medication error, the data shown were not mutually exclusive. Medication errors related to morphine in four incidents (36.3%), ephedrine in two incidents (18.1%), and one incident (9.1%) each of atropine, succinyl choline, atracurium, midazolam, oxygen, and intravenous fluid. Out of the 11 incidents, four incidents (36.3%) were near miss incidents. Type of medication errors were classified as drug overdose in two incidents (18.1%), no label in three incidents (27.3%), wrong label in one incident (9.1%), omit dose after drug preparation in two incidents (18.1%), wrong drug in three incidents (27.3%), wrong concentration in one incident (9.1%), and syringe swab in one incident (9.1%). Nine cases (81.8%) developed no adverse outcome, two incidents (18.1%) developed minor physiologic changes, and one incident (9.1%) experienced unplanned intensive care unit admission as immediate outcome. After reviewing by senior anesthesiologists, 11 incidents (100%) were considered as anesthesia related incidents and eight incidents (72.7%) were systemic factor particularly guidelines matter.

Among seven incident reports of peripheral neurological deficit, there were four cases (57.1%) of cesarean delivery and three cases (42.9%) of orthopedic surgery undergoing spinal anesthesia, of which two incidents (28.6%) experienced paresthesia during performance of spinal block and one incident (14.2%) had three spinal anesthetic attempts due to difficult procedural technique. After reviewing the incidents, there were one incident (14.2%), two incidents (28.6%), and five incidents (71.4%) considered as patient factor (obesity), surgical factors such as surgical injury and position problem, and spinal anesthesia factors, respectively. All but one fully recovered while one felt numbness beyond one week after the operation.

There were two cases of intraoperative oxygen desaturation due to air embolism from pressure bag of IV fluid and preoperative pulmonary disease. Another two cases developed oxygen desaturation in the post-anesthesia care unit due to preoperative pulmonary disease and postoperative pulmonary edema. Two out of four cases necessitated unplanned intensive care unit admission.

Equipment malfunction in the present study occurred in one case of monitoring equipment temporally dysfunction and a case of electrical power failure with inadequate preanesthetic compliance to checklists. The only one case of pulmonary aspiration was a case of spinal anesthesia wear off necessitating general anesthesia and pulmonary aspiration that occurred during induction and intubation. Oxygen saturation increased to normal level in the intensive care unit.

Summary of immediate and 7-day adverse outcome regarding spinal anesthesia in the present study are shown in Table 3.

Most of adverse events (95.2%) were detected by clinical diagnosis while 77.2% of the incidents

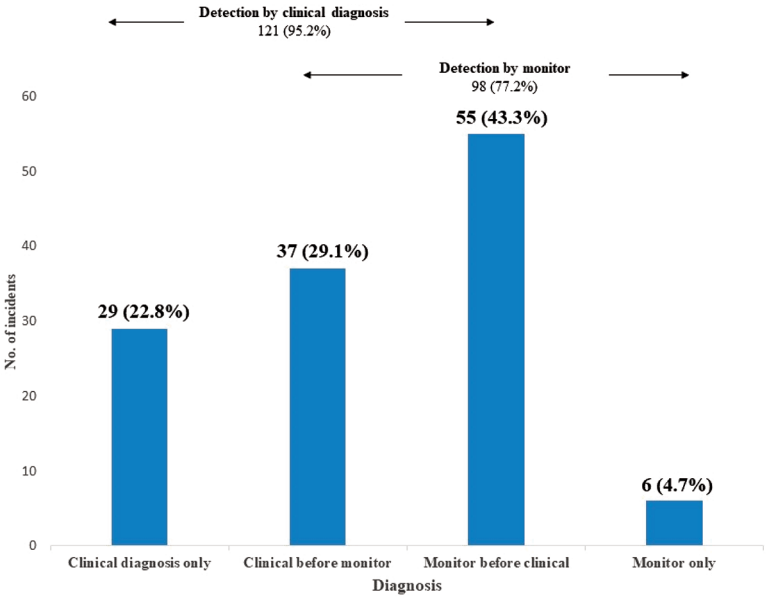

Figure 1. Detection of adverse events after spinal anesthesia.

Table 3. Immediate and long-term outcomes (n=127)

	n (%)
Immediate outcome	
Unplanned intensive care unit admission	11 (8.7)
Minor physiological changes	45 (35.4)
Major physiological changes	
• Respiratory system	8 (6.3)
• Cardiovascular system	12 (9.3)
• Neurological system	13 (10.2)
Intraoperative cardiac arrest	7 (5.5)
Complete recovery	79 (62.2)
Long term outcomes	
Prolonged hospital stay	
• Less than 7 days	10 (7.8)
• Longer than 7 days	5 (3.9)
Prolonged ventilatory support	2 (1.6)
Vegetative state	2 (1.6)
Complete recovery	20 (15.7)
Death	6 (4.8)

Data are not mutually exclusive

were detected by monitoring equipment. Detection by monitoring equipment before clinical diagnosis was more common (43.3%). Details of the methods of diagnosis or mean of detection of the incidents are shown in Figure 1. Monitoring equipment that detected the occurrence were electrocardiography, NIBP monitoring, and pulse oximetry, in 75 cases (59.0%), 13 cases (10.2%), and 10 cases (7.9%), respectively.

Discussion

Due to the invasive nature of spinal anesthesia, there are several types of complications that may occur with different incidence and concern for both patient and anesthesiologist and may lead to litigation. It is important to document these incidents to identify the risk factors and for the patient's information. There is also a need to revisit these contributing factors as they may change over time. In addition, increasing co-morbidities, concomitant medication, surgery for advanced malignancy, patients with compromised immune systems, as well as instances of infection poses a real challenge to the use of spinal anesthesia[3]. Moreover, patients with degenerative vertebral anomalies, elderly patients, or those who have undergone previous spinal surgeries are also possible risks in spinal anesthesia[1,3].

Bradycardia and cardiac arrest are the most worrisome complications related to spinal anesthesia[1-4]. Bradycardia has been observed to be higher with spinal block in comparison with general anesthesia[1]. In the present study group, bradycardia of 40 beats or less per minute was most common adverse events confirming the national guidelines of RCAT to monitor both pulse oximeter and electrocardiography in all cases of spinal anesthesia for early detection of

bradycardia, severe arrhythmia, and other adverse events. However, the number of incidents decreased compared to the Thai Anesthesia Incidents Monitoring Study (Thai AIMS) of Adverse Events after Spinal Anesthesia[6]. Because of the definition of bradycardia was changed from 50 beats per minute, to 40 beats per minute, the incidents decreased from 74.4% to 50.4%. However, bradycardia remain as the most common complication and most of bradycardia can be resolved non-eventful, but we had one a case of fatality. The study by Chatzimichali et al emphasized that assessment of heart rate variability in the preoperative period may help to determine perioperative severe bradycardia[7]. However, the Australian Monitoring Study (AIMS) incidence related to spinal block was fewer (2.1%) compared with the present study[8]. After implementation of the modified clinical practice guideline for monitoring of the RCAT in 2007, the present study revealed very good compliance of monitoring with NIBP monitoring (98%), pulse oximeter (99%), and electrocardiagraphy (99%) in 2015.

Critical incidents occurred more frequently in male patients. This might be due to common surgeries involved were orthopedic and urological surgeries. More than 40% of the incidents occurred in patients whose age was 60 years or older. This is also a factor as Thailand is becoming an aging society. However, one-fourth of critical incidents still occurred in healthy patients receiving anesthesia and surgery.

Cardiac arrest was an important complication of anesthesia. The present study revealed an incidence of 1.13:10,000 (95% CI 0.55 to 2.33) intraoperative cardiac arrest after spinal anesthesia. This is fewer than the authors' previous report in 2008 with an incidence of 2.7:10,000 spinal anesthesia. There were 11 cases of 24 hours cardiac arrest in patients receiving spinal anesthesia, including intraoperative cardiac arrest. This revealed an incidence of 1.77:10,000 (95% CI 0.99 to 3.17) spinal anesthesia, which was fewer than the authors' previous report and the French study[9,10]. The possible explanation might be the improvement of anesthesia care such as spinal anesthesia, which was mostly performed by anesthesiologist after 2008. However, there was a patient who developed cardiac arrest within 24 hours at ward whose spinal anesthesia was still performed by a surgeon. In the Thai Anesthesia Incident Study (THAI Study), surgeon as performer of spinal anesthesia had 23 folds for occurrence of intraoperative cardiac arrest[9]. The 7-day mortality after cardiac arrest in the present study decreased to 28.6% compared to the authors' previous registry.

There were sub-studies of suspected PE, medication error, suspected myocardial ischemia, and peripheral nerve injury recently published in the series of the PAAd Thai Study[11-13]. In the present study, details of such adverse events regarding anesthesia were emphasized, which included five incidents of suspected PE with only two cases confirmed by echocardiography. Orthopedic and obstetric patients revealed potential risk for diagnosis of suspected PE, a rare but very serious complication that may lead to fatality. However, some studies showed that PE clinical manifestations during spinal anesthesia could be misleading for high spinal especially during cesarean section and therefore, immediate diagnosis and prompt treatment should be prioritized for improvement of survival rate[14]. Suspected PE in the present study showed a high mortality rate of 40%.

Eighteen incidents of anaphylaxis or anaphylactoid reaction or drug allergy were observed. The most common suspected etiologic agents were antibiotics, opioids, and several type of colloid, similar to previous studies. Most of occurrence were mild and could be solved by conservative treatment. However, 11.1% of incidents were severe and needed unplanned admission to the intensive care unit. History of drug allergy was a mandatory item to be asked during preanesthetic period, however only 5% of the incidents had previous history of allergic reaction to medication. Patient and anesthesia factors were considered by three senior anesthesiologists to play a role in the occurrence of anaphylaxis or anaphylactoid reaction or drug allergy incidents.

Common medication errors were related to opioids particularly morphine, vasopressor, and several other agents. One third of the occurrences were considered as near miss incidents. Other types of medication errors were drug preparation without labelling, drug overdose, wrong drug, omit dose, wrong concentration, and syringe swab, respectively. Most of the incidents developed no adverse outcome and mild physiological disturbance. However, one case needed intensive care unit admission with no mortality. For medication error incidents in the present study, three-fourths of the occurrences were system factor such as guidelines compliance while all occurrences were considered as anesthesia related and human error. Currently in Thailand color labeling guidelines are followed to prevent medication error[12,15]. The use of barcode scanning, especially if combined with synthesized voice reading of the drug name as a form of double-checking, offers a potential

solution for such issues. In addition, needle, catheter, and syringe connection redesign has perhaps the greatest potential to minimize these risks in future.

Similar to other adverse events regarding spinal anesthesia, peripheral nerve injury was detected in seven cases, which was in lower proportion than those occurring in other anesthetic techniques confirming that spinal anesthesia is quite safe to administer. In other study, the incidence of nerve injury after spinal anesthesia was also lower[13].

In the present study, detection or diagnosis of adverse event were monitoring only in 4.7% and clinical diagnosis only in 22.8%. Most incidents were detected by monitoring before clinical diagnosis. Figure 1 demonstrates that monitoring equipment was important to assist anesthetic personnel in detection of adverse event particularly electrocardiography and blood pressure monitoring. Pulse oximetry could firstly detect incident in only 8%. However, the present study showed the importance of clinical detection in most incidents. In the present study, the higher portion of incident occurred in male patents who undergone orthopedic and urosurgery compared to female. Moreover, the patients age above 60 showed higher risk of complications, while the cesarean section was among younger patient needing good monitoring for early detection and prompt treatment of adverse events.

In the present study, two-thirds of the incidents led to complete recovery. Furthermore, one-third of the incidents led to minor physiologic change, and one-fourth of the incidents led to major physiologic changes. Seven intraoperation cardiac arrest (5.5%) and 11 unplanned intensive care unit admission (8.7%) were among the serious immediate outcomes. The incidents also lead to long term outcomes such as prolong hospital stay, prolonged ventilatory support, vegetative state, and death within seven days.

After review by senior anesthesiologists, the common contributing factors were inexperience, inappropriate decision making, inadequate pre-anesthetic evaluation, and haste. The incidents might be minimized by vigilance, having experience, having an experienced assistant, compliance to the guidelines, and effective consultation. The suggested corrective strategies were quality assurance activity such as morbidity-mortality conference, guidelines, supervision, and additional training as shown in Table 4.

The present study has several limitations. First, the present study is based on a non-randomized controlled trial. However, some of critical incidents were hard indicators systemically reported. Second, there might be under-estimate in many critical incidents. The authors chose incidents of interest for improving quality and safety. Despite these limitations, the present data may provide useful information on the spinal anesthesia, particularly in developing countries. In present study, many of the highlighted complications can be reduced with meticulous attention to the details during the performance of the spinal block. The procedure may be more patient-oriented and convenient by selecting the appropriate technique, drugs, and their doses, as well as doing a careful risk and benefit assessment. It is of prime importance that the incidence should be monitored, as this can reduce serious adverse outcomes. To decrease serious complications, knowing patients at risks and adherence to the guidelines for monitoring appear to be fundamental. Further studies are warranted to follow up quality and safety regarding anesthesia

Table 4. Contributing factors, factors minimizing incidents, and suggested corrective strategies

	n (%)
Contributing factors	
Inexperience	26 (28.3)
Surgical safety checklists	2 (1.6)
Decision making	12 (9.4)
Haste	10 (7.9)
Emergency	8 (6.3)
Inadequate preanesthetic evaluation	10 (7.9)
Inappropriate preoperative preparation	8 (5.5)
Labelling problem	3 (2.4)
Inadequate personnel	2 (1.6)
Communication problems	2 (1.6)
Factors minimizing incidents	
Vigilance	86 (67.7)
Having experience	76 (59.8)
Experienced assistant	37 (29.1)
Compliance to guidelines	11 (8.7)
Consultation system	10 (7.9)
Effective communication	8 (6.3)
Suggested corrective strategies	
Quality assurance activity	60 (47.2)
Guidelines	58 (45.7)
Improvement of supervision	28 (22.0)
Additional training	25 (19.7)
Improvement of communication	6 (4.7)

Data are not mutually exclusive

particularly in post-COVID 19 era.

In summary, the present study was the multicenter incident reports study. It showed that the incidence of cardiac arrest during spinal anesthesia and cardiac arrest within 24 hours after performing spinal anesthetic technique were uncommon, with the incidence of 1.13 per 10,000 and 1.77 per 10,000 anesthetics, respectively. Common groups of patients having cardiac arrest were patients that underwent orthopedic surgery, urological surgery, and cesarean delivery. Other common adverse events were bradycardia, anaphylaxis or anaphylactoid reaction or drug allergy, or medication error. Suggested corrective strategies were quality assurance activity, adherence to the guidelines particularly monitoring guidelines, improvement of supervision, and additional training.

What is already known on this topic?

Spinal anesthesia is safe anesthetic technique with potential occurrence of complications. Cardiac arrest during anesthesia is uncommon. Bradycardia anaphylaxis or anaphylactoid reaction or drug allergy, and medication errors are common. Experience performers such as board-anesthesia certification and anesthesiologist directed anesthesia care has better outcomes.

What this study adds?

Spinal anesthesia performed in Thailand is safe. Cardiac arrest during anesthesia was uncommon with current incidence of 1.13 per 10,000 anesthetics. Suggested strategies regarding spinal anesthesia were quality assurance activity, adherence to the clinical practice guidelines and monitoring guidelines, improvement of supervision, and additional training.

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Conflicts of interest

The authors declare no conflict of interest.

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