Quality Assessment of Anesthesia Service at Siriraj Hospital

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Abstract

As part of a quality assurance program, the quality of the anesthesia service at Siriraj Hospital was assessed by using a newly developed data collecting system to find the incidence of clinical indicators. During a 7-month period (June-December 2001), 14,036 anesthetics were included for evaluation. The mortality rate within 24 hours and CPR rate during anesthesia were equal at 20.6/10,000. Other clinical indicators were major anesthetic complications (mainly airway, respiratory and cardiovascular system) 144.8/10,000, drug mishaps and adverse drug reactions 6.4/10,000, anesthetic equipment related complications 3.5/10,000 and patient's dissatisfaction 30.6/10,000. Patterns of some complications were also reported. The implications of the results; comparison to international standard, prioritization of the problems, baseline information before intervention, recognition of complication patterns and guidance to future system management and research projects; were discussed.

In conclusion, we demonstrated the effective data collecting system and its results and implication for quality assurance program.

Key word : Quality Assessment, Anesthetic Complications, Risk Management

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Anesthesia service plays an important role in the multidisciplinary medical cares by facilitating and implementing the treatment and investigation to achieve the goals in a safe and sound manner. The quality of the anesthesia service has been traditionally assessed by retrospectively reviewing the complications or problems related to anesthetic care[1]. However, the process of data collection is much more

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complicated because most significant incidences occurring during anesthetic care have been recognized and solved without any residual detectable signs to be traced back unless they are honestly reported by the anesthesia personnel. To obtain this information, a comprehensive and consistent but simple data collecting system as well as the cooperation and coordination of the involved personnel at all levels are required.

Anesthesia related events have been collected in our department for regular morbidity and mortality conferences among the staff, residents, nurse anesthetists and nurse students on a bi-monthly basis for more than 10 years. They were grossly underreported due to personnel's unwillingness to disclose such the adverse events. Using this incomplete data as the indicators for quality assessment may lead to inappropriate prioritization of the problems and quality improvement of the service.

Since 2000, our department has applied the concept of risk management which is one of the key elements of hospital accreditation to improve the quality of patient's care. This has motivated all personnel in the department to recognize the importance of risk identification and assessment as a part of risk management and led to the establishment of a new quality assessment system starting on May 1, 2001. By selecting the key indicators with clear objectives emphasizing quality improvement of the service and with the agreement and cooperation of the personnel, we have set up a simple and precise system for quality assessment.

The main objective of this system is to assess the quality of all anesthesia services in all patients who receive anesthetic care at Siriraj Hospital by prospectively studying the incidences of serious anesthetic complications and patient's satisfaction of the anesthetic care. The main indicators include 1) Mortality rate during anesthesia and within 24 hours, 2) Cardiopulmonary resuscitation (CPR) rate during anesthesia, 3) Major complications during anesthesia, 4) Drug mishaps and adverse drug reactions, 5) Anesthetic equipment related complications, and 6) Patient's satisfaction.

METHOD

We prospectively collected the data of all patients who received anesthetic care from all services at Siriraj Hospital during May-December 2001. The study was comprised of two main steps.

Data collection

As this is a new data collecting system, the tool used to collect the information is at least as important as the collecting process itself. The record forms for collecting data are as follows:

1. A perioperative anesthetic record form for collecting the patients' demographic data, major incidences occurring during anesthesia and information from the postoperative visit. Every patient receiving anesthetic care had their information recorded into this form by the anesthetic team while postoperative visits were done by the residents who had taken care the patients or by assigned nurse anesthetists (3-5 persons each day).

2. An anesthetic incident record form, a check-off form printed on the reverse side of the anesthetic record, used for reporting complications occurring during anesthesia.

3. A morbidity and mortality record form for the residents or staff to report written information of critical events including details of the events, causes, management, outcome and suggestion for prevention. This information is to be taken for discussion in the morbidity and mortality conferences. The conference working group consisting of third year residents and supervisory staff, encourages the residents or staff responsible for patients experiencing anesthetic complications to write the details of the events and present the information in the conference.

4. An occurrence record form, used for reporting the occurrence related to drug administration during anesthesia such as wrong drug, wrong dose or any adverse reaction. This form is to be filed by anesthetic personnel in the event of drug mishaps.

Data evaluation

For the purpose of accuracy and completeness, the investigators had also gathered and compared information from other sources including reports of morbidity and mortality conferences from the department of surgery, orthopedics, obstetrics and gynecology.

The data were reviewed and analyzed by the department's incidence report working group using the peer review system. After monthly analysis, the details of information were presented in the morbidity and mortality conference to make all the personnel aware of the outcome of the quality assessment and initiate the a positive impact to the practice of the personnel.

RESULTS

Demography

It was intended to start this study at the beginning of May 2001 but the completion rate of record forms was less than 60 per cent due to several practical problems during this initial period. Therefore, the data in this study was compiled between June and December 2001 (7-month period) which included a total of 14,036 anesthetic cares. The distribution of patients was not different from the entire year data (Table 1). Anesthetic records of 12,920 (92.0%) and perioperative anesthetic record form of 11,842 (84.3%) were completed for evaluation. For postanesthetic visit, 10,290 patients (73.3%) were adequately followed-up, 1,749 patients (12.4%) were discharged before the visit, the remainder of 1,997 patients (14.3%) mainly undergoing surgery or procedure in the cardiothoracic or neurosurgical anesthesia service were not included in this study due to their specific problems. Their data was collected in a separate study.

Events and adverse outcomes

1. Mortality (Table 2)

The overall mortality rate was 29 in 14, 036 (20.6/10,000). All of the 29 deaths were in the patients with ASA class 3-5, which was equivalent to 242.6 per 10000. No death was found in the patients of ASA class 1-2. There were 10 patients who died during anesthesia. Nineteen patients died within 24 hours after anesthesia. Eight of these patients underwent CPR during anesthesia (see below), the remaining were patients undergoing emergency operations with massive hemorrhage, severe brain edema or severe sepsis.

2. Cardiopulmonary resuscitation (Table 2)

Twenty-nine patients were resuscitated by external cardiac massage or defibrillation for cardiac arrest or impending cardiac arrest during anesthesia. Nineteen of these patients were successfully revived. Eight patients in this group subsequently died within 24 hours, 3 patients were left with permanent brain damage and the remaining 8 patients fully recovered without any residual damage. There were 2 patients in ASA class 1-2 undergoing CPR which was equivalent to 1.5 : 10000. The causes of cardiac arrest in these 2 patients were due to inadequate respiration. There were 27 patients, 225.9 : 10000, in ASA class 3-5 undergoing CPR.

3. Major anesthetic complications occurred in 199 out of 14,036 cases or 144.8/10,000 (Table 2)

3.1. Airway and respiratory problems occurred in 113 out of 14,036 cases or 80.5/10,000 (Table 3).

Table 1. Demographic and case characteristic data comparing the study period to the entire year.

Case characteristics	January-December 2001	%	June-December 2001	%
Case				
Total	23,969		14,036	
Elective	19,363	80.8	11,366	81.0
ASA I-II	17,938	74.8	10,467	74.6
ASA III-V	1,425	6.0	899	6.4
Emergency	4,606	19.2	2,670	19.0
ASA I-II	4,106	17.1	2,374	16.9
ASA III-V	500	2.1	296	2.1
Anesthetic technique				
General anesthesia	15,925	66.4	9,392	66.9
Mask or LMA	1,302	5.4	741	5.3
Orotracheal intubation	13,096	54.6	7,811	55.6
Other	1,527	6.4	840	6.0
Regional anesthesia	7,613	31.8	4,528	32.3
Spinal anesthesia	4,478	18.7	2,667	19.0
Epidural anesthesia	1,150	4.8	684	4.9
Brachial plexus block	786	3.3	447	3.2
Other	1,199	5.0	730	5.2
Unspecified	431	1.8	116	0.8

Table 2. Results of clinical indicators.

Clinical indicators	N/Total	Rate per 10,000
Mortality rate		
Total	29/14,036	20.6
ASA I-II	0/12,841	0
ASA III-V	29/1,195	242.6
CPR rate		
Total	29/14,036	20.6
ASA I-II	2/12,841	1.5
ASA III-V	27/1,195	225.9
Major anesthetic complications	199/14,036	144.8
Airway and respiratory complications (see details in Table 3)	113/14,036	80.5
Cardiovascular complications (see details in Table 4)	76/14,036	54.1
Other (see details in text)	10/14,036	7.1
Drug mishap or adverse drug reaction	9/14,036	6.4
Complications related to anesthetic equipment	5/14,036	3.5
Patient's dissatisfaction	43/14,036	30.6

Table 3. Airway and respiratory complications.

Complications	Rate per 10,000	Remarks
Total	80.5 (n=113)	
Difficult intubation	37 (n=53)	36 expected and 17 unexpected difficult intubation
Late detection of esophageal intubation	2.8 (n=4)	
Problems related to endotracheal tube	11.3 (n=16)	10 endobronchial intubation, 4 obstruction of endotracheal tube (3 from secretion and 1 from kinking of endotracheal tube) and 2 unintentional disconnection of endotracheal tube
Severe sore throat and hoarseness	4.2 (n=6)	1 arytenoid dislocation, 1 vocal cord paralysis, 3 chemical inflammation of oropharynx and 1 unknown cause
Upper airway obstruction	17.1 (n=24)	Intraoperative period 4 cases (during GA with mask), postoperative period 20 cases (13 excessive sedation, 7 airway edema or vocal cord paralysis)
Pulmonary aspiration	4.2 (n=6)	
Pulmonary edema	3.5 (n=5)	1 case from upper airway obstruction and 4 cases from hypervolemia

Difficult intubation

Fifty-three cases of difficult intubation were reported. Thirty six cases were expected and 17 cases were not. All patients with expected difficulty of intubation were successfully intubated, except one whose airway needed to be secured by tracheostomy. Of the 17 unexpected difficult intubations, three were impossible to be intubated and subsequently received general anesthesia with mask or laryngeal mask airway instead. Unexpected difficult intubation resulted in two events of dental injury (three-tooth dislodgement in two patients) and 3 events of prolonged oxygen desaturation (arterial oxygen saturation, SpO2, lower than 90 per cent for more than 3 minutes).

Late detection of esophageal intubation

Four events occurred during the study period and caused prolonged desaturation but no permanent damage was detected.

Problems related to endotracheal tube

A total of sixteen events were considered significant, unintentional endobronchial intubation in 10 patients, obstruction of endotracheal tube in 4 patients (3 from secretion and 1 from kinking of endotracheal tube) and unintentional disconnection of endotracheal tube from the breathing circuit in 2 patients (one of them had cardiac arrest from hypoventilation)

Table 4. Cardiovascular complications.

Complications	Rate per 10,000	Remarks
Total	54.1 (n=76)	
Intraoperative arrhythmias*	10 (n=14)	3 severe bradycardia, 4 atrial fibrillation and 7 premature ventricular contraction
Unstable hemodynamics**	36.3 (n=51)	21 preoperative hemodynamic instability, 10 inadequate volume resuscitation, 9 combined general and regional anesthesia, 7 spinal block and 4 unspecified cause
Suspected myocardial ischemia***	7.8 (n=11)	7 cases required nitroglycerin infusion

* defined as new abnormal cardiac rhythm shown on electrocardiographic monitor requiring treatment either antiarrhythmic drug or cardioversion.

** defined as significant fluctuation of blood pressure especially severe hypotension at the systolic blood pressure < 80 mmHg in adults which required more than 3 intermittent boluses of vasopressor.

*** defined as a new ST segment change on EKG monitoring.

Severe sore throat and hoarseness

Six patients were discovered to suffer from this problem after general anesthesia. The causes were dislocation of the arytenoid cartilage in 1 case, vocal cord paralysis in 1 case, chemical inflammation of the oropharynx in 3 cases and unknown cause in 1 case whose symptom was spontaneously resolved within 24 hours. It was speculated that the cause of chemical inflammation was due to residual cleansing antiseptic left on the reusable endotracheal tube. The department's cleaning and disinfection working group investigated the cleaning process of airway equipment and found that too high a concentration of antiseptic was used. After changing of the antiseptic concentration we have not encountered this problem anymore.

Upper airway obstruction

Of the total 24 events, four took place intraoperatively during general anesthesia with mask and required airway management with endotracheal intubation. Postoperative airway obstruction occurred in 20 patients. Thirteen of them were due to excessive sedation after general anesthesia and the remaining 7 patients were caused by airway edema or vocal cord paralysis (4 out of 7 underwent airway or neck surgery). The management was reintubation in 18 patients and tracheostomy in 2 patients.

Pulmonary aspiration

Six patients, 2 emergency and 4 elective cases, suffered from the aspiration.

Pulmonary edema

A total of 5 patients were diagnosed with pulmonary edema, 1 case from upper airway obstruction and 4 cases from a hypervolemic state.

3.2. Cardiovascular problems (Table 4)

Intraoperative arrhythmias

Fourteen patients developed new malignant arrhythmias (requiring treatment either antiarrhythmic drugs or cardioversion) during anesthesia which included 3 cases of severe bradycardia, 4 cases of atrial fibrillation and 7 cases of multifocal premature ventricular contraction (PVC). It should be noted that 5 of these patients developed multifocal PVC during rigid bronchoscopy. One patient suffered multifocal PVC caused by hypercarbia due to disconnection of the anesthetic breathing circuit.

Unstable hemodynamics

Fifty-one patients were found to experience severe unstable hemodynamics (defined as significant fluctuation of blood pressure especially severe hypotension at the systolic blood pressure<80 mmHg in adults which required more than 3 intermittent boluses of vasopressor). Twenty one of these were patients with severe hemorrhage or sepsis and preoperative hemodynamic instability before undergoing emergency operations while the remaining 30 patients developed this problem intraoperatively. Causes of hemodynamic instability in the latter group can be categorized as follows:

- *Inadequate volume resuscitation* in 10 patients. One of them experienced intraoperative cardiac arrest twice during the same operation and subsequently suffered permanent brain damage.

- *Combined general and regional anesthesia*, especially thoracic epidural and spinal block, in 9 patients from total of 296 cases receiving combined anesthetic technique.

- *Spinal block* in 7 patients from total 2,667 cases receiving spinal anesthetic technique. It should be noted that 4 of them were more than 70 years of age.

- *Unspecified cause* in 4 patients who received general anesthesia. Operation was postponed for 7 days in one patient due to persistent hypotension.

Suspected myocardial ischemia (defined as new ST segment change on EKG monitoring)

Eleven patients had been reported to experience this problems and 7 of them received nitroglycerin infusion intraoperatively.

3.4. Other problems: Awareness in 3 patients, transient radicular irritation (TRI) from spinal anesthesia with hyperbaric lidocaine in 1 patient and pneumothorax in 6 patients (5 from brachial plexus block and 1 from central venous catheter insertion).

4. Drug mishaps or adverse drug reaction

There was a total of 7 drug mishaps such as using nitroglycerin or aminophylline instead of normal saline or sterile water as a diluent. One patient to whom atracurium was mistakenly given as supposed to fentanyl in the recovery room, became apneic and was subsequently intubated.

Two severe anaphylactic reactions were discovered in one patient from a total 5 of operations during the study period.

5. Complications related to anesthetic equipment

From 5 events, 3 were the result of disconnection of anesthetic breathing system, 1 was due to inadvertent malposition of the carbon dioxide absorber bypass knob resulting in hypercarbia and the last one was caused by a foreign body (staple clip) retained within the endotracheal tube lumen (found after intubation) without sign of airway obstruction (it was later removed by excising the proximal part of the endotracheal tube). The last event led to an abandonment of the use of staples for the packaging of airway instruments.

6. Patient's satisfaction

Forty three patients reported dissatisfaction toward the anesthetic care they received. Among these, 27 patients admitted that they were frightened by the teaching session they overheard, 7 patients were disturbed by other noise in the operating theater and the other 9 patients were simply afraid of being in the operation room.

DISCUSSION

The emergence of hospital accreditation in Thailand has necessitated a quality assurance (or risk management) program which critically emphasizes the identification of rates and etiologies of patient-related problems to improve patient care by the modification of clinical practice[2,3].

The results of this study offers several advantages to our newly developed quality assurance program which can be categorized as follows:

Incidence of clinical indicators

The incidence of clinical indicators serves at least 3 main purposes

Comparison with international standard

Olsson GI and Hallen B conducted a computer-aided study of cardiac arrest during anaesthesia in 250,543 anaesthetics. The overall mortality was 2.4/10000 anesthetics and the mortality caused by anesthesia was only 0.3/10000 anesthetics. The incidence of anesthetic cardiac arrest according to the ASA score was 7.8/10000 for ASA I-II and 37.7/10,000 for ASA III-V[4].

In the CEPOD study which assessed nearly a million cases of anesthesia during a 1-year period in 1987 in three large regions of the United Kingdom. Deaths within 30 days of surgery were included in the study. There were 4,034 deaths in an estimated 485,850 operations, resulting in a crude mortality rate of 0.7 to 0.8 per cent. Anesthesia was considered the sole cause of death in only 3 individuals, for a rate of 1 in 185,000 cases, and anesthesia was contributory in 410 deaths, for a rate of 7 in 10,000[5].

Comparing our results to the above two studies, the perioperative mortality and CPR rate of the population with ASA class I-II in our study were not significantly different but it is obvious that in patients with ASAIII-V, both incidences were 5-6 times higher in our population. Possible explanations would be 1) the quality of our anesthetic care in high risk population was inferior to tertiary care hospitals

in developed countries 2) more proportion of patients with ASA IV-V or more sophisticated operations were included in our study and 3) anesthesia might have contributed to only a few deaths or cardiac arrests as our study did not differentiate the causes into anesthesia related or surgery related. These issues of course require further exploration. In the meantime, the investigators will encourage more supervision by both anesthesia and surgical staff for perioperative care of patients in this high risk group.

Prioritization of the problems

The frequency and severity of adverse events justify the urgency of risk control. The minor complications which frequently occur are as important as the rare but fatal complications. The complications which result in devastating outcome and happen more often than usual require the most emergency attention(6). The clustering of damaging events suggests that risk management strategies directed at just a few areas of clinical practice could result in large quality improvement. Similar to ASA closed claim study, our study showed that respiratory system events were responsible for most of the adverse outcome, 53.0 per cent of total events (not including mortality and CPR). In the ASA closed claim study, adverse respiratory events were mostly considered preventable with early recognition by using pulse oximetry, capnometry, or a combination of these two monitors and, more importantly, with the vigilance of anesthesia personnel(7). Since, capnometry is not a routine monitor (non-invasive blood pressure, EKG, pulse oximetry) in our institute, to include this expensive equipment in every single general anesthetic care requires thorough consideration especially in the era of new universal coverage health care reform. Meanwhile other means, such as increasing the awareness and expanding the knowledge of the personnel as well as more supervision, should be implemented right away.

Risks which potentially cause catastrophic outcome but can readily be controlled also require special attention. These risks should be managed without delay. In our study, 2 examples were demonstrated. First, we discovered several drug mishaps in a short period of time. Because of this, we decided to change from hand written drug labels on the syringe to a preprinted form. The second example was chemical inflammation of the oropharynx causing severe sore throat which led to investigation and correction of the cleansing process of reusable endotracheal tubes as mentioned earlier.

Baseline information

For the purpose of comparing the incidence of clinical indicators before and after intervention, having our own baseline information is useful for the continuing process of quality assurance.

Recognition of complication patterns

Patterns of adverse outcomes allow us to identify risk factors and may guide us to a practice which avoids unwanted outcomes. This technique has been used successfully in the ASA closed claim study. Several patterns leading to the untoward events were discovered in this study such as 13 postoperative upper airway obstructions from a total of 20 events. These were due to excessive residual sedation after general anesthesia, 5 out of 14 intraoperative arrhythmia events occurred during general anesthesia for rigid bronchoscopy, 9 events of severe unstable hemodynamics occurred during combined general and regional anesthesia and 27 out of 43 patients who were dissatisfied with the anesthetic care were frightened by the academic discussion between the staffs and the trainees in their presence. Identification of these risk patterns would lead to strategies to prevent and control the problems.

Implication for future system management and research projects

System management

The compliance of our staff in completing the perioperative anesthesia record form and making postoperative visits was quite high in our study. We believe that the hospital accreditation system has alerted medical personnel to be aware of the significance of a quality assurance program leading to more cooperation. A more organized collecting system of record forms and better analysis system were certainly the catalytic elements.

The strength of our new data collecting system were its simplicity and good organization by setting up the precise roles of each person and frequent auditing of the system. Moreover, our system to analyze the data made information more available for peer review and thus gain a more meaningful

morbidity and mortality conferences, less finger pointing to the person responsible for the events and more attention to what happened and what could be different next time to prevent such the complications. We also believe that the new version of the conferences has influenced the personnel to be more willing to disclose events and cooperate with the data collection.

The weakness of our system included lack of event details in the data collecting system, possibility of underreporting and concealment and peer review without non-anesthesia personnel. Some corrective means such as a second record form may compromise the compliance and should therefore be carefully considered.

Research projects

The results of our study are preliminary but still are able to suggest that several area of practice require improvement. The research projects to investigate the risk or contributory factors and the impact of intervention will help guide the direction for future modification.

SUMMARY

By using a new data collecting system, which was more organized and systematic, the quality of the anesthesia service, represented by incidences of various clinical indicators, at Siriraj Hospital was assessed. The indicators were mainly major adverse events and outcomes. The results showed that the perioperative mortality and CPR rate in high risk group patients at our institute were higher than those of tertiary care center in developed countries. Airway, respiratory and cardiovascular adverse events accounted for more than 80 per cent of all major anesthetic complications.

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การประเมินคุณภาพการบริการทางวิสัญญี ณ โรงพยาบาลศิริราช

ฐิติมา ชินะโชติ, พ.บ., สุวรรณี สุรเศรณีวงศ์, พ.บ.*, ทรงยศ วลัยฤาชา, พ.บ.*, ธารา ติตระการ, พ.บ.**,

ระบบการประเมินคุณภาพการบริการทางวิสัญญี ณ โรงพยาบาลศิริราชได้รับการปรับปรุงให้มีประสิทธิภาพสูงขึ้นในการค้นหาอุบัติการณ์ของเครื่องชี้วัดต่าง ๆ โดยเฉพาะผลแทรกซ้อนทางวิสัญญีที่รุนแรง เพื่อตอบรับกับงานพัฒนาคุณภาพของโรงพยาบาล ผลการประเมินในระยะการศึกษา 7 เดือน (มิถุนายน–ธันวาคม 2544) พบว่ามีการระงับความรู้สึกทั้งหมด 14,036 ครั้ง อัตราตายภายใน 24 ชั่วโมงหลังการระงับความรู้สึก เท่ากับ 20.6 ต่อ 10,000 อัตราการปฏิบัติการกู้ชีพระหว่างการระงับความรู้สึก เท่ากับ 20.6 ต่อ 10,000 เช่นกัน สำหรับเครื่องชี้วัดอื่น ๆ พบ อัตราการเกิดผลแทรกซ้อนทางวิสัญญีที่รุนแรง 144.8 ต่อ 10,000 (ส่วนใหญ่เป็นผลแทรกซ้อนเกี่ยวกับทางเดินหายใจ ระบบหายใจ ระบบหัวใจและหลอดเลือด) อัตราการให้ยาผิดหรือการแพ้ยาที่รุนแรง 6.4 ต่อ 10,000 อัตราการเกิดผลแทรกซ้อนที่เกิดขึ้นจากอุปกรณ์ทางวิสัญญี 3.5 ต่อ 10,000 และ อัตราความไม่พอใจของผู้ป่วยต่องานบริการทางวิสัญญี 30.6 ต่อ 10,000 ผลการศึกษาได้ค้นพบแบบแผนที่มีลักษณะจำเพาะของผลแทรกซ้อนบางอย่างด้วย ผลที่ได้จากการศึกษานี้มีประโยชน์ในด้านต่าง ๆ ดังนี้ 1) การเปรียบเทียบคุณภาพกับมาตราฐานต่างประเทศ 2) การจัดลำดับความสำคัญของปัญหา 3) ข้อมูลพื้นฐานก่อนการพัฒนาปรับปรุง 4) การตรวจหาแบบแผนที่มีลักษณะจำเพาะของผลแทรกซ้อน 5) แนวทางในการปรับปรุงระบบการประเมินคุณภาพการบริการ และ 6) แนวทางในการศึกษาวิจัย

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