Original Article

Failed Intubation in the Perioperative and Anesthetic Adverse Events in Thailand (PAAd Thai) Study: Perspectives of Technical Skills and Anesthetists' Non-Technical Skills (ANTS)

Sasikaan Nimmaanrat MD, MMed (Pain Mgt)[1], Prae Plansangkate MD, PhD[1], Wanna Angkasuvan MD[2], Thidarat Ariyanuchitkul MD[3], Toonchai Indrambarya MD[4], Wichai Ittichaikulthol MD[5], Jeratkana Janngam MD[6], Somkhuan Dechasilaruk MD[7], Aksorn Pulnitiporn MD[8], Karuna Rajinda MD[9]

[1] Department of Anesthesiology, Faculty of Medicine, Prince of Songkla University, Hat Yai, Songkhla, Thailand
[2] Department of Anesthesiology, Hatyai Hospital, Hat Yai, Songkhla, Thailand
[3] Department of Anesthesiology, Maharat Nakhon Ratchasima Hospital, Muang, Nakhon Ratchasima, Thailand
[4] Department of Anesthesiology, Faculty of Medicine, Chulalongkorn University, Bangkok, Thailand
[5] Department of Anesthesiology, Faculty of Medicine, Ramathibodi Hospital, Mahidol University, Bangkok, Thailand
[6] Department of Anesthesiology, Bangkok Metropolitan Administration General Hospital, Bangkok, Thailand
[7] Department of Anesthesiology, Buddhachinaraj Hospital, Pitsanulok, Thailand
[8] Department of Anesthesiology, Khonkaen Hospital, Khonkaen, Thailand
[9] Sunprasitthiprasong Ubon Ratchathani Hospital, Ubonratchathani, Thailand

Objective: The Royal College of Anesthesiologists of Thailand (RCAT) has performed the study called "The Perioperative Anesthetic Adverse Events Study in Thailand (PAAd Thai)". It was a multi-center, prospective, observational trial conducted in 22 hospitals throughout Thailand in 2015. This study is a part of the PAAd Thai which specifically aimed to focus on failed intubation with the view of technical skills and Anesthetists' Non-Technical Skills (ANTS).

Materials and Methods: The PAAd Thai working group created a standardized incident record form. Each incident including failed intubation was reported directly to a center of data management using this form. Two anesthesiologists (SN, PP) separately used the ANTS behavioral rating tool (4 categories, 15 elements) to assess performances of the healthcare providers involved in each incident report of failed intubation.

Results: Among 2,206 incident reports, there were 16 cases (0.7%) of failed intubation. Overall incidence per 10,000 with 95% CI was 0.74 (0.38 - 1.10). More than half of them were not obese. Difficult intubation was predicted in 56.25% of the cases. McIntosh blade was the most frequently used equipment. Five cases were cancelled while 11 went on for surgery using either a laryngeal mask airway (55%) or tracheostomy (45%). The 2 most common complications were hypoxia (43.75%) and esophageal intubation (12.50%). No cardiac arrest happened. With ANTS, there was 0 case which the 2 authors had the same ratings for all elements. Moreover, none of the elements were marked with the same ratings by the 2 authors. Identifying options as well as balancing risks and selecting options (decision making) were rated in concordance for 12 incident reports. Conversely, prioritizing (task management) as well as using authority and assertiveness (team working) accounted for 0 agreement.

Conclusion: The incidence of failed intubation was low and no case experienced very serious complications. Using the ANTS scoring system to evaluate performances of anesthetic practitioners from the incident reports showed various agreements between the 2 authors.

Keywords: Failed intubation, Technical skills, Non-technical skills, Anaesthetists' Non-technical skills

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Correspondence to:

Nimmaanrat S. Department of Anesthesiology, Faculty of Medicine, Prince of Songkla University, Hat Yai, Songkhla 90110, Thailand.
Phone: +66-88-7907842, **Fax:** +66-74-429621
Email: snimmaanrat@yahoo.com.au

The Royal College of Anesthesiologists of Thailand [RCAT] has performed the study which is so called "The Perioperative Anesthetic Adverse Events Study in Thailand [PAAd Thai]". It was a multi-center,

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prospective, observational study conducted in 22 hospitals throughout the nation in 2015[1].

This study is a part of the PAAd Thai which specifically aimed to focus on failed intubation with the view of Anesthetists' Non-Technical Skills [ANTS]. Apart from technical skills, non-technical skills [NTS] are also mandatory for excellent performance[2].

The ANTS tool is a skills taxonomy and behavioral rating system used for self-reflection, training, workplace evaluation, stimulation debriefing and incident analysis[3]. It was developed by a team of anesthesiologists and psychologists in Scotland[4] using approaches of mission analysis in the same way as the NOTECHS system for pilots[5]. Testing for its validity, reliability and usability demonstrated that the system is complete, the skills are observable and can be ranked with acceptable levels of agreement and accuracy[4].

Materials and Methods

This study is a part of the Perioperative Anesthetic Adverse Events Study in Thailand [PAAd Thai] which was conducted by the Royal College of Anesthesiologists of Thailand [RCAT]. The PAAd Thai was a multi-center, prospective, observational study commenced in 2015 from January 1st until December 31st. It was designed to evaluate the incidence of anesthetic complications and related factors leading to these adverse events. Moreover, its analyzed data will be utilized to set up the preventive and corrective strategies to reduce the occurrence of anesthetic complications and improve outcomes including patient safety[1].

Twenty-two hospitals from the North to the South and the West to the East of Thailand accompanied this study. The PAAd Thai working group created a standardized incident report form. Each incident was reported by using this standardized form and filled in by anesthesiologists or nurse anesthetists. The completed incident report forms were directed to a center of data management[1].

Failed intubation is one of the adverse incidents reported. We used the ANTS behavioral rating tool to assess performance of the healthcare providers involved in each incident report. The ANTS system has 4 skill categories and beneath these are 15 skill elements. The 4 categories comprise of task management, team working, situation awareness and decision making. The task management consists of 4 elements (planning and preparing, prioritizing, providing and maintaining standards as well as identifying and utilizing resources). The team working covers 5 elements (coordinating activities with team members, exchanging information, using authority and assertiveness, assessing capabilities as well as supporting others). The situation awareness contains 3 elements (gathering information, recognizing and understanding as well as anticipating). Last but not least, the decision making involves 3 elements (identifying options, balancing risks and selecting options as well as re-evaluating). Each element has a 4-point rating scale (1 - poor, 2 - marginal, 3 - acceptable, 4 - good, N - Not observed)[6].

The PAAd Thai standardized incident report form consisted of 2 parts; constructed format and free text explanation of events describing what happened. The 2 authors (SN, PP) separately and carefully read the incident reports and utilized the ANTS marker system to rate each element of each case. Statistical analysis was performed by using R software 2.14.1.

Results

The 22 engaged hospitals performed 333,219 anesthetic services during the 1 year period of data collection. From these, 2,206 incident report forms were sent back to the data management centers for analysis[7].

Among 2,206 incident reports, there were 16 cases (0.7%) of failed intubation. Overall incidence per 10,000 with 95% CI was 0.74 (0.38 - 1.10) [7]. If all 216,179 general anesthetic services were considered, failed intubation accounted for 0.00007% or 0.05 failed intubation per 10,000 services. Patient characteristics are illustrated in Table 1. The majority of cases were not obese. Nine cases were predicted as 'difficult intubation'. Grade IV laryngoscopic view was detected in 8 cases. Technical data of 16 cases of failed intubation are represented in Table 2. Induction was prompted before performing intubation in the majority of cases. The conventional airway equipment, McIntosh laryngoscope blade was the most common selected device to use for the first attempt of intubation. Almost half of the cases were cancelled while the rest were continued with either a laryngeal mask airway or tracheostomy (surgical airway). Table 3 reveals complications related to failed intubation. Hypoxia was the most common adverse event followed by esophageal intubation. No seriously severe complication such as cardiac arrest occurred.

The 2 authors (SN, PP) separately used the ANTS System Rating Scale to assess the non-technical skills based on incident reports (Table 4).

Using the ANTS system rating for analyzing the

Table 1. Demographic data of failed-intubated patients (n = 16)

	Number	%
Gender		
Female	7	43.75
Male	9	56.25
Age (years)		
0-12	3	
12-64.9	9	
≥ 65	4	
ASA classification		
I	1	6.25
II	6	37.50
III	8	50.0
IV	0	0.0
V	0	0.0
Not stated	1	6.25
Body mass index (kg/m^2)		
<18	0	0.0
18-24.9	8	50.0
25-27.9	1	6.25
≥28	2	12.50
Not stated	5	31.25
Mallampati grading		
1	2	12.50
2	3	18.75
3	3	18.75
4	2	12.50
Could not evaluate	4	25.0
Not stated	2	12.50
Thyromental distance		
≥ 5 cm	10	62.50
< 5 cm	3	18.75
Not evaluated	2	12.50
Not stated	1	6.25
Predicted difficult intubation		
No	7	43.75
Yes	9	56.25
Laryngoscopic view		
1	2	12.50
2	1	6.25
3	3	18.75
4	8	50.0
Not stated	2	12.50

ASA: American Society of Anesthesiologists

16 incident reports of failed intubation, we found 0 case which the 2 authors had the same ratings for all elements. Moreover, none of the elements was marked with the same ratings by the 2 authors. There was no agreement on prioritizing (task management). Using authority and assertiveness (team working) indicated 2 concordances of the 2 authors among the 16 incident reports. (Tables 4 and 5) Identifying options as well as balancing risks and selecting options (2 elements under the category of decision making) were rated in concordance for 12 incident reports. Two element was rated with 10 concordances (gathering information as well as recognizing and understanding), both are beneath the category of situation awareness. Conversely, prioritizing accounted for 0 concordance while using authority and assertiveness as well as re-evaluating and assessing capabilities accounted for 2 and 3 concordances, consequently.

The number of "high concordances" with agreements of both authors on the rating ranks of 3 and 4 were extracted to show in Table 5. Identifying options together with balancing risks and selecting options received the highest agreements for 12 cases. These 2 elements of high concordances are with the category of decision making (Table 5).

In regard to the number of "Not observed" for each element; the highest number of "Not observed" was found in supporting others followed by exchanging information together with using authority and assertiveness, prioritizing, re-evaluating, coordinating activities with team as well as assessing capabilities, respectively. In contrast, planning and preparation, providing and maintaining standards, identifying options as well as balancing risks and selecting options were not rated with "Not observed". Recognizing & understanding was labelled with 1 "Not observed" marker while gathering information and anticipating received 2 and 3 "Not observed" markers, respectively (Table 5).

The number of concordances of "Not observed" were also derived. Supporting others received 5 concordances of "Not observed", exchanging information received 3, coordinating activities with team members as well as using authority and assertiveness received 2 each, and assessing capabilities as well as re-evaluating received 1 each. The other elements received 0 concordance of "Not observed" (Table 5).

Discussion

This study has found the low incidence of failed intubation. With regards to Anaesthetists' non-technical skills [ANTS], there was no case that the 2 authors assigned the same rating scale for all elements, and none of the elements was marked with the same ratings by the 2 authors.

There were 16 incident reports of failed intubation among 2,206 incident report forms (0.7%) and 216,179 general anesthetic services (0.00007%). The overall incidence was 0.74 per 10,000 cases[7]. In comparison to the previous THAI Study which was conducted from 1st February 2003 to 31st January, 2004, it revealed 50 failed intubation[8] cases among 98,871 general anesthetic services. (0.0005%)[9]. These 2 studies (THAI Study and PAAd Thai) were performed more

Table 2. Technical data regarding failed intubation (n = 16)

	Number	%
First attempt		
Techniques		
Intubation after induction	11	68.75
Awake intubation	5	31.25
Equipment		
McIntosh laryngoscope blade	8	50.0
McCoy laryngoscope blade	0	0.0
Video laryngoscope	3	18.75
Fiberoptic	3	18.75
Tube exchanger	1	6.25
Not stated	1	6.25
Number of intubation attempts (mean±SD)	4.6±1.8	
Number of cancelled operations	5	31.25
Operations continued with other airway devices (n = 11)		
Laryngeal mask airway	6	55.0
Tracheostomy	5	45.0

Table 3. Complications from failed intubation (n = 16)

Complications	Number	%
Hypoxia	7	43.75
Esophageal intubation	2	12.50
Airway injury	1	6.25
Bradycardia	0	0.0
Laryngospasm	0	0.0
Bronchospasm	0	0.0
Cardiac arrest	0	0.0

than 10 years apart. The availability of new airway equipment such as various kinds of videolaryngoscopes likely to play a major role in reducing the incidence of failed intubation.

Difficult intubation was predicted in approximately half of the cases (n = 9, 56.25%). The majority of our failed intubation patients were not obese with BMI less than 25 kg/m^2. However, it has been revealed that 37% of airway problems occurring at anesthesia induction is associated with obesity[10]. A cohort study from the Danish Anesthesia Database has demonstrated that high BMI of 35 kg/m^2 or more, is a weak but statistically significant predictor for difficult and failed intubation[11].

Laryngeal mask airway [LMA] and tracheostomy were 2 methods implemented in failed intubation cases proceeding with the scheduled surgery. This practice was in concordance with the guideline proposed by the Difficult Airway Society [DAS][12].

Hypoxia is the commonest cause of airway-related death[13] and was the most frequent complication in this study (n = 7, 43.75%). However, we found no cardiac arrest among our failed intubation cases. LMA was utilized to ventilate 5 of the hypoxic patients and probably the rescue method to lessen the severity of hypoxemia and risk of death.

From the point of view of ANTS, there was no case that the 2 authors assigned the same rating scale for all elements. In addition, none of the elements was marked with the same ratings by the 2 authors. Different attitudes and experiences may take part to explain these findings. Graham et al. conducted a study and reported that an 8-hr program could not train anesthesiologists to reliably use ANTS as a summative evaluating instrument. They thought that 2 chief contributing factors to the lack of agreement included (1) observed performances were erroneously classified into wrong element and (2) safety beliefs varied among anesthesiologists[14]. Moreover, our study was to use the ANTS scoring system to judge behaviors written in the incident reports, not to judge performances by seeing the real, videotaped or simulating scenarios. To assess behaviors from reading only what mentioned in the case reports is extremely limiting because other good / poor behaviors not mentioned, are unknown. We did not know whether the involved anesthesiologists and other anesthetic providers in the incident reports, did what should not have been done or did not do what should have been done, or not.

We discovered that identifying options as well as balancing risks and selecting options were the highest elements that the 2 authors gave the same opinions. Both of them are under the category of decision making. The category of situation awareness showed 2 elements with 10 concordances (gathering information as well as recognizing and understanding). Using authority and assertiveness as well as re-evaluating and assessing capabilities accounted for very low numbers of concordances while prioritizing revealed

Table 4. System Rating for Anesthetists' Non-Technical Skills by 2 authors (16 incident reports)

Categories	Elements	Rating																													
		1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16	
		A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
Task management	Planning & preparation	4	4	4	4	1	2	1	3	4	3	4	2	2	3	4	2	4	4	4	4	4	2	4	4	3	2	2	3	4	4	4	4
	Prioritizing	3	N	4	N	1	N	4	N	4	N	3	N	3	N	4	N	4	N	4	N	4	N	4	N	2	N	3	N	4	N	4	N
	Providing & maintaining standards	3	4	4	4	1	2	3	2	4	3	3	3	3	3	4	2	4	4	4	4	4	3	4	4	3	2	3	2	4	4	4	4
	Identifying & utilizing resources	3	3	4	4	3	4	4	4	4	3	3	3	4	4	4	N	4	N	4	N	4	N	4	4	2	2	3	N	4	4	4	3
Team working	Coordinating activities with team members	N	N	N	N	4	4	4	N	4	4	N	2	4	4	4	4	4	4	4	N	4	N	4	N	3	3	3	N	4	N	4	N
	Exchanging information	N	N	N	N	4	N	4	N	4	N	N	N	4	N	4	N	4	4	4	N	4	N	4	N	3	N	3	N	4	N	4	N
	Using authority & assertiveness	N	N	4	N	4	N	4	N	4	N	N	N	4	N	4	N	4	N	4	N	4	N	4	N	2	N	3	N	4	N	4	N
	Assessing capabilities	N	N	N	4	4	N	4	N	4	N	N	2	4	3	4	N	4	4	4	N	4	2	4	N	2	2	3	3	4	N	4	4
	Supporting others	N	N	N	N	N	N	N	N	4	N	N	N	4	N	4	N	4	N	4	N	4	4	4	N	2	3	3	N	4	N	4	N
Situation awareness	Gathering information	4	4	4	4	1	2	2	4	4	4	3	4	4	N	4	N	4	4	4	4	4	3	4	4	3	3	3	3	4	4	4	4
	Recognizing & understanding	4	3	4	4	4	2	4	4	4	4	3	3	4	3	4	N	4	4	4	4	4	3	3	4	3	3	3	3	4	4	4	4
	Anticipating	2	4	4	4	1	4	3	4	4	4	4	2	4	N	4	4	4	3	4	N	4	4	4	4	3	N	2	3	4	4	4	4
Decision making	Identifying options	3	3	4	4	3	4	4	4	4	4	3	3	4	4	4	3	4	4	4	4	4	4	4	4	2	4	4	3	4	4	4	4
	Balancing risks & selecting options	3	4	4	4	3	4	4	4	4	4	3	3	4	3	4	4	4	4	4	4	4	4	4	4	2	3	4	4	4	4	4	4
	Re-evaluating	N	N	4	N	4	N	4	N	4	N	3	3	4	3	4	N	4	N	4	N	4	N	4	N	3	N	4	N	4	4	4	N

4 - Good; 3 - Acceptable; 2 - Marginal; 1 - Poor; N - Not observed

Table 5 Concordances between the 2 authors for ANTS rating and the total numbers of "High concordances" and "Not observed" (16 incident reports)

Categories	Elements	Number of concordances	Number of "High concordances"*	Number of "Not observed"	Number of concordances of "Not observed"
Task management	Planning & preparation	7	7	0	0
	Prioritizing	0	0	16	0
	Providing & maintaining standards	8	8	0	0
	Identifying & utilizing resources	8	7	5	0
Team working	Coordinating activities with team members	8	6	12	2
	Exchanging information	4	1	18	3
	Using authority & assertiveness	2	0	18	2
	Assessing capabilities	5	3	11	1
	Supporting others	6	1	19	5
Situation awareness	Gathering information	10	10	2	0
	Recognizing & understanding	10	10	1	0
	Anticipating	7	7	3	0
Decision making	Identifying options	12	12	0	0
	Balancing risks & selecting options	12	12	0	0
	Re-evaluating	3	2	14	1

* High concordance: agreement on rating levels of 3 (acceptable) or 4 (good)

0 agreement between the 2 authors. These 3 elements may represent the most difficult behaviors to judge by using the ANTS scoring system on the incident reports. It may be easier to justify the 2 performances (using authority and assertiveness as well as prioritizing) in real life, videotaped or simulation scenarios as they are easier to observe more than extracting from the written incident reports. For re-evaluating and assessing capabilities, we suppose that it is not difficult to determine from the incident reports but the involved anesthetic providers did not write adequate details on this part.

The explanations for all 4 points of the rating scale are not only performance levels but they also indicate their correlation with patient safety[15]. Under these circumstances, the number of "high concordances" with agreements of both authors on the rating ranks of 3 and 4 were specially drawn into attention. Surprisingly, the elements with concordances are also the elements with high concordances. These 4 elements (identifying options, balancing risks and selecting options, gathering information as well as recognizing and understanding) may be easy to identify from the incident reports. Besides, these performances are standard and routinely practiced and maintained, these make them receive the high ranks (acceptable and good). Considering that this study utilized the ANTS scoring system to appraise the behaviors of the anesthesiologists and anesthetic providers in dealing with failed intubation which is not an uncommon situation, so they are familiar with this crisis and able to manage it very well. As previously mentioned, the 4-point rating scale is associated with patient safety so we assume that these 4 elements with high performance indexes are an indication for patient safety in terms of airway management.

We also focused on the number of "Not observed" or N. One author gave N for 2 elements (prioritizing as well as using authority and assertiveness) in all of the failed intubation reports. It may be not easy to determine these 2 elements from reading the incident reports, without seeing performances by any mean of direct observation, videotaped scenarios or stimulating setup situations. On the contrary, 4 elements were not quoted with N (planning and preparation, providing and maintaining standards, identifying options as well as balancing risks and selecting options). It may be not difficult to assess these 4 elements from reading the incident reports as they usually contain these data.

Emphasizing on the number of concordances of "Not observed", all 5 elements under the category of team working received the agreements on N. It may be difficult to extract behaviors of team working from reading the incident reports because no behavior is really seen or observed. In addition, the incident reports usually give no detailed information on these performances. Interestingly, all elements of the 2 categories (task management and situation awareness) were not rated with any agreement on N. All these 7 elements may be easier to identify even from analysis the incident reports.

This study has a number of strengths. It is a part of the Perioperative Anesthetic Adverse Events Study in Thailand [PAAd Thai] which was conducted by the Royal College of Anesthesiologists of Thailand [RCAT], the main body of anesthesiologists in this country. It was a large-scale multi-center study collecting the incident data for a period of 12 months from 22 hospitals covering all regions of Thailand. Besides, ANTS which is a reliable and valid behavioral rating system[4], has been utilized for evaluating performances of anesthetic practitioners for a certain period of time but there is no ANTS study specifically performed to assess the incident reports of any adverse outcome. The incident reports are materials basically used in everyday real-life practice. This study is the first trial to utilize ANTS for analyzing the incident reports of failed intubation.

The ANTS scoring system should be implemented into daily anesthetic practice and training for the next generation because it has been well acknowledged that good anesthesia is a result of both technical skills and non-technical skills[2]. Additionally, the data from all studies under the umbrella of PAAd Thai including this particular study, will be utilize to establish the preventive and corrective strategies to lessen the presence of anesthetic complications and enhance the better anesthetic outcomes such as patient safety in particular. Apart from ANTS, the Oxford Non-Technical Skills [NOTECHS] scale is the other valid and reliable tool to evaluate teamwork (surgical, anesthetic and nursing subteams) in the operating room[16].

This study was based on voluntary reports from the involved hospitals which is considered as one of the weaknesses. Some data were missing from the incident report forms. It was also a descriptive study. In addition, using data from medical incident reporting system offer limited insight into non-technical skills[17].

Conclusion

From PAAd Thai, the incidence of failed intubation was low and no case experienced very serious complications. Using the ANTS scoring system to evaluate performances of anesthetic practitioners from the incident reports showed various agreements between the 2 authors.

What is already known on this topic?

Risk factors and complications of failed intubation.

What this study adds?

By using Anaesthetists' Non-Technical Skills (ANTS) behavioral rating tool (4 categories, 15 elements) to evaluate performances of anesthetic providers involved in failed intubation incidence, the 2 authors have various agreements and disagreements on each element.

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Potential conflicts of interest

The authors declare no conflicts of interest.

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