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Research

Swedish Registered Nurse Anesthetists' Understanding of Difficult Airway Algorithms

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A B S T R A C T

Purpose: To explore Swedish registered nurse anesthetists' (RNAs') different ways of understanding difficult airway algorithms.
Design: A qualitative study design, using a phenomenographic approach, was chosen to describe variations in RNAs' understanding of difficult airway algorithms.
Methods: Individual interviews were conducted with eighteen RNAs working at three hospitals in Sweden. The data were analyzed using a qualitative method.
Findings: Three ways of understanding algorithms were identified: (1) Algorithms constitute a plan not communicated at the clinic; (2) Algorithms constitute a shared plan to improve teamwork; (3) Algorithms constitute a plan for how to think and work systematically.
Conclusions: According to the RNAs, airway management algorithms should be discussed more openly at the workplace. RNAs expressed their desire to have a shared algorithm and to use it as a tool during team simulations. Airway algorithms were seen as constituting a plan for how to think and work systematically to improve patient safety.

A difficult airway, unpredicted or not, presents a challenging task for anesthesia professionals. During recent years, to increase the safety of airway procedures, anesthesia societies have updated their strategies and algorithms for management of difficult airway in adults.[1,2] One of the first to present practice guidelines for management of the difficult airway in the literature was the American Society of Anesthesiologists (ASA),[2] which defines difficult airway as a clinical situation in which anesthesia professionals experience difficulties with face mask ventilation, tracheal intubation, or both. The concept "algorithm" is widely used in health care, and use of algorithms is known to standardize patient care and improve patient outcomes (ie, "evidence-based guidelines"). In anesthesia care, an airway algorithm has been described as a decision tree that indicates how to manage a patient's airway when it fails.[3] The term algorithm also refers to guidelines, checklists or protocols designed to provide guidance for managing patients under anesthesia, including airway complications. Although airway algorithms have been published, systematic literature reviews have shown that human factors are still of importance in preventing anesthesia-related complications.[4] Schnittker et al.[5] identified both barriers to and enablers of successful airway management. Having the right airway equipment immediately available for securing the airway and having an algorithm to fall back on in time-pressured situations are seen as useful, whereas individual personalities and a hierarchical culture at the workplace can impair successful airway management. Research has also found that non-technical skills, such as situational awareness, decision-making, and teamwork during performance, contribute to safer procedures, just as in other health care practice, especially during cardiopulmonary resuscitation (CPR) scenarios.[6,7] According to Myatra et al.[8], optimizing education in both technical and non-technical skills regarding difficult airway management is of importance and should be practiced regularly to reduce risk. In addition, using a readily available cognitive visual aid, in the form of a poster and/or an algorithm, during an airway emergency, and training has been shown to improve patient safety.[9] On the other hand, the use of cognitive aids in emergency and routine anesthesia is highly dependent on the

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anesthesia providers' own clinical experience and whether they use available algorithms.[10] Furthermore, anesthesiologists reported that an algorithm with too many steps is difficult to memorize and not easy to follow in critical situations.[11]

In general, practical guidelines and algorithms have been described as challenging to implement in health care.[12] Studies have identified both barriers to and enablers of implementation of and compliance with a variety of evidence-based guidelines. For example, lack of organizational plans, lack of leadership support and lack of continued education on how to use guidelines are considered barriers, while personal factors such as communication skills, teamwork and repeated training in use of the guidelines are seen as enablers.[13,14]

These studies showed that successful implementation of cognitive aids in operating room (OR) crises was associated with a supportive organizational context and that following a multi-step implementation process increased clinicians' familiarity and cultural acceptance. Current research lacks registered nurse anesthetists' (RNAs') views and knowledge concerning use of guidelines such as airway algorithms when handling difficult airways. To our knowledge, no studies have explored how RNAs think and act when using difficult airway algorithms in critical situations. In order to study this, phenomenography can be a suitable method. Phenomenography is a qualitative research method developed in Sweden in the 1970s. Its aim is to determine the ways in which a group of people understand or experience a phenomenon.[15] The present study is an attempt to deepen our knowledge about how RNAs experience using difficult airway algorithms in their daily practice. The purpose of the study was to explore Swedish RNAs' different ways of understanding difficult airway management algorithms.

Material and Methods

A qualitative design with a phenomenographic method was chosen to describe variations in RNAs' understanding of difficult airway algorithms.[15] The data were collected through individual interviews, the most common method of data collection in qualitative research.[16] The Ethical Review Board of Uppsala, Sweden, approved the study (Diary number 2014/491).

Setting

The present study was conducted at one university trauma teaching hospital, and two community hospitals in Sweden. In total, around 44,600 general anesthetic procedures are performed in these hospitals annually. In Sweden, most of the anesthetic procedures are performed independently by RNAs on healthy patients (ie, ASA physical grade 1-2), after a prescription issued by an anesthesiologist.[17] In their daily practice, RNAs and anesthesiologists work closely together and assist each other with patients at risk of intubation problems (ie, ASA grade 3-5).

Participants and Procedure

According to Marton,[15] people understand a specific phenomenon in a limited number of qualitatively different ways, and to capture these ways, individual interviews can be conducted. The present sample consisted of 18 RNAs. According to the phenomenographic research, this is a suitable number for finding different ways of understanding.[18] To achieve variation in how airway algorithms are understood, a purposive sampling procedure was used. Inclusion criteria were being an RNA and having a minimum of 2 years working experience in anesthesia care. Exclusion criteria were RNAs being in an administrative position and not being actively involved in direct patient care. The head of each anesthesia department was contacted by e-mail for help in distributing written information about the study. Thereafter, during a workplace meeting at each site, appointments were made with RNAs who voluntarily agreed to participate; they had no prior relationship with the interviewer. Eighteen RNAs signed a written informed consent form before their respective interviews began. Using this procedure, maximize variation was automatically achieved in gender (10 women, 8 men), age (31-65 years, median 44), clinical experience as an RNA (2-44 years, median 11), and number working at the three hospitals (n = 9, 5, and 4, respectively). None of the included RNAs dropped out during the interviews.

Data Collection

An interview guide was designed in collaboration with a researcher with extensive experience of phenomenography. The interview guide was pilot tested on two anesthesia professionals before the study began, resulting in minor adjustments to the guide. These pilot interviews were not included in the study. Three main, open-ended questions were asked to encourage the RNAs to describe their experience of a situation when they had handled a difficult airway. The three main questions and probing questions are presented in Table 1. All interviews were performed by the first author (KK); the interviews were conducted face-to-face, during the daytime, in a quiet room, at the RNAs' respective workplaces, and lasted for 15 to 60 minutes (median = 31min). The interviews were audio-taped and transcribed verbatim by KK after all of the interviews had been conducted. Data collection was carried out from January to February 2015.

Data Analysis

The data analysis was performed in accordance with the five steps described by Larsson and Holmström[19]:

Step 1. The transcripts were read through several times by the first author (KK) to become familiar with the interview text.
Step 2. On each transcript, text sections where the RNAs described their experiences of using algorithms in difficult airway situations or reflected on such experiences were selected so as to map the range of understandings.
Step 3. For each interview, these selected text sections were condensed into a description of what the RNAs thought about algorithms and then summarized into a preliminary way of understanding.

Table 1
Questions Asked During the Interview with RNAs, Including Probing Questions

Three main questions	Probing questions
1. Can you give an example of a situation when you were involved in managing a difficult airway?	Did you use an algorithm that helped you manage the situation? Can you describe your thoughts afterwards?
2. What do you think about algorithms, such as guidelines, protocols, or decision aids?	Can you tell me more about that? What do you mean?
3. Can you describe a situation where you felt that you were successful in managing a difficult airway, and a situation where you were not successful?	Can you give more examples? What did you think would happen?

Table 2
An Example of the Analysis Process, from the Interview Text to Different Ways of Understanding Airway Algorithms Among RNAs, and the Category of Understanding

Interview text	Different ways of understanding	Category
I know that there are many airway guidelines, but it's nothing we have a routine dialogue about here at our workplace We talk too little about airway algorithms. If you compare with CPR, for example, there's a very strict plan for what to do, and at which time, and you practice this at least once a year. . .	• Algorithm is viewed as a tool that is not discussed routinely • Algorithm is just a tool, not communicated clearly and implemented in practice	(A) Algorithms constitute a plan not communicated at the clinic

Step 4. The remaining preliminary ways of understanding were actively compared and, based on their similarities and differences, placed into different categories by two of the researchers (KK, UP). The analysis in this step focused on the RNAs' collective understandings and not on their individual experiences.

Step 5. Each category was discussed and constantly checked against the transcript for accuracy during the analysis process until agreement on the main categories was reached within the research group. An example of the main categories, from Step 3-5, is presented in Table 2.

The analysis involved an interactive process performed by two of the authors (KK, UP). To achieve confirmability, the category descriptions were thereafter discussed in dialogue with the entire research team, all of whom had experience of qualitative research methodology (KK, UP, MH, UN) and, specifically, of phenomenographic research.[16] All but one author (UP) had experience with difficult airways from work in anesthesia care.

Results

We categorized three ways of understanding difficult airway algorithms among the RNAs; several of the RNAs expressed more than one way of understanding difficult airway algorithms (Table 3). The categories are described below together with illustrative quotations from the interviews.

(1) Algorithms constitute a plan not communicated at the clinic

RNAs with this understanding view algorithms as a plan that is not introduced or discussed at the workplace. The RNAs reported that airway algorithms were used more often by anesthesiologists, and that RNAs were less familiar with using them as a tool in their daily work. Lack of knowledge about existing algorithms among RNAs and not being up to date on the newest recommendations were described as barriers. RNAs in this category view algorithms as a tool for the anesthesiologists that is not communicated to or available for them. If the anesthesiologists truly follow a specific algorithm, the RNAs want them to share this with the RNAs to make the plan visible.

> *It's the anesthesiologists who decide which algorithm to use. If they've discussed beforehand which one to follow, then it's good if it can be introduced to all of us. . . //. The only time I remember any kind of algorithm being used was when it was really difficult. The anesthesiologists may have been thinking about the algorithm, but it was not mentioned explicitly (F5).*

(2) Algorithms constitute a shared plan to improve teamwork

RNAs with this understanding view an airway algorithm as a shared plan to improve teamwork. It is important to have a shared airway algorithm and for both anesthesiologists and RNAs to follow the same plan to avoid misunderstandings and errors as well as to improve patient outcomes. In difficult airway situations, teamwork, including a team leader, and having an algorithm in mind are useful in improving performance; the algorithm also provides support. Possessing the relevant knowledge and having discussed a "Plan A and B" in advance with the anesthesiologists make the work easier. On the other hand, RNAs say they do not always do so.

> *. . .have something that everyone knows how to do, to get the work done more efficiently, when needed. If you have it in mind, as a support (S1).*

Table 3
Ways of Understanding Difficult Airway Algorithms

	Years of working experience	Sex	Category (A) Algorithms constitute a plan not communicated at the clinic	Category (B) Algorithms constitute a shared plan to improve teamwork	Category (C) Algorithms constitute a plan for how to think and work systematically
S3	2	F			x
U1	4	M		x	x
S1	5	M		x	x
S4	5	M	x	x	
F6	7	M	x		x
F2	7	F		x	x
F3	7	M		x	
F4	9	M	x	x	x
S2	9	M			x
F7	13	F		x	
U4	14	M		x	x
F9	14	F		x	
F8	18	F		x	
F5	24	F	x		
U5	29	F		x	x
F1	30	F		x	
U2	38	F	x	x	x
U3	44	F		x	x

X, Category presented.

It's really important that we have an algorithm, because we're such different personalities working together and we have different ways of solving things, so I think it's good to rely on ... (F7)

It turned out that the algorithms are the physicians, but we also have to know in order to give support, even if they're the ones who decide and know the problems, we can help and make wise suggestions (F2).

The plan should be practiced repeatedly in simulation scenarios intended to improve teamwork, including essential communication in the team, and to improve patient outcomes. Mastering a shared algorithm increases feelings of security. It was considered important for the RNAs to communicate airway procedures and difficult airway algorithms to enforce compliance.

You need to practice communication skills because no one can see what you're thinking ... you actually need to talk about it out loud (U5). // More simulation training in different scenarios to practice communication skills.

(3) Algorithms constitute a plan for how to think and work systematically

RNAs with this understanding view algorithms as a guide for how to think and work systematically, as a framework to rely on. Having a plan to follow during difficult airway situations was described as useful, because it means being mentally prepared and one step ahead. Critical situations are stressful, and following a stepwise plan minimizes the risk of mistakes and adverse events that may result from stress reactions and tunnel vision. To be useful in clinical practice, an airway algorithm should have only a few steps and include commonly used equipment. An algorithm must be simple to memorize, just like CPR. Airway algorithms are thought to provide a useful plan that enables more efficient work and increases patient safety, especially when anesthesia professionals are less skilled. This gives a sense of security. One risk associated with algorithms, a risk that decreases with experience, is that one may adhere to them too strictly and, thereby, be unable to adapt the plan to the specific situation. The RNAs acknowledged that real patients are not like textbook examples. They talked about needing to think outside the box to successfully manage a difficult airway, especially when working outside the anesthesia department.

If you have a guideline, it's like baking a cake. If you're a little bit stressed, it's easy to think wrong. But once you have a recipe, like a guideline, you'll memorize it, and then you can make a cake (S3)

. . . We have these CPR posters set up everywhere. And it would be good if we could have these algorithms printed on the resuscitation trolley, so you can think and remember... (F6).

It looks so easy when you read an algorithm, but you must have gone through some difficult airway situations before you understand and grasp it. The longer you've worked and the more unusual situations you've been through, the more modest you get, and then you understand (F4).

Discussion

The aim of the present study was to explore Swedish RNAs' different ways of understanding airway algorithms. The results revealed three ways of understanding, presented in the following categories: (1) Algorithms constitute a plan not communicated at the clinic; (2) Algorithms constitute a shared plan to improve teamwork; (3) Algorithms constitute a plan for how to think and work systematically.

In Sweden, airway algorithms are recommended as a stepwise plan to follow in order to ensure safer airway procedures,[20] but the RNAs' views on using a difficult airway management algorithm varied. In Category A, algorithms were viewed as a plan not communicated in clinical practice. The RNAs reported that they had read about airway algorithms in textbooks and that airway algorithms were useful, but not commonly used as a tool in clinical practice. This understanding could be a problem, as solving airway problems is complex. Managing patients with a difficult airway is a team effort, and poor communication between anesthesia professionals at the workplace does not promote good teamwork. To practice anesthesia care and to ensure and improve the quality of care for their patients, RNAs must continuously read and use scientific research.[17] RNAs and anesthesiologists have overlapping responsibilities in difficult airway situations and may act as each other's source of expertise, thus breaking down hierarchical barriers.[5] These findings may reflect a lack of knowledge about their professional responsibility for continuous learning and for applying evidence-based practice (EBP), the goal of which is to achieve patient safety.[21] This assumption is strengthened by a recent finding showing that one understanding of evidence-based nursing among bedside nurses is that the concept is fragmentary and difficult to use in clinical practice. However, a deeper understanding of the importance of working in an evidence-based manner at different levels of clinical practice has been reported as well,[22,23] which supports our results in Category B and C: The majority of RNAs included in our study reported having positive attitudes towards using algorithms as a tool for EBP.

Regardless of sex and years of working experience, the majority understood airway algorithms in line with Category B, where algorithms were viewed as a shared plan to improve teamwork. This understanding is evident especially among male RNAs, who also had shorter working experience. If both RNAs and the anesthesiologists follow the same algorithm, it could reduce mistakes and thereby improve patient safety.[1,2,5,6] RNAs are seldom left on their own to deal with difficult airway situations, as an anesthesiologist is usually present in such situations.[20] During a difficult airway situation, it is important that all involved professionals in the team know what is expected of them, so they can perform their respective tasks with confidence and safety. A directed review by Edelman et al.[24] found that many algorithms are quite similar but differ in terminology related to equipment availability and local recommendations. They concluded that more attention should be paid to human factors, such as the professional's own role and communication between professionals, to ensure the best patient outcomes. During critical situations, both the RNAs and the anesthesiologist can act as allied professionals, resulting in a belt-and-braces approach that improves patient safety.[25] But airway problems can occur unexpectedly, and when this happens, RNAs need to have the knowledge and skills required to deal with the situation on their own. Although these situations are rare, assuming professional responsibility for being up to date on the content of a difficult airway algorithm may be vital in ensuring patient safety. Having a shared algorithm is important, as this allows RNAs to feel prepared when they are alone and airway problems arise. Moreover, interprofessional simulation training of critical stressful situations has been described as an effective strategy for successful outcomes.[7,8,26] Although several anesthesia societies have updated their guidelines for airway management, the findings show that evidence-based algorithms are poorly introduced among professionals. Arguments for not using airway algorithms are that they are too rigid and that they do not take patients' individual anatomical characteristics or specific situations into account.[11]

In Category C, algorithms were viewed as a plan for how to think and work systematically and as a framework to rely on during difficult airway situations, which supports results from another qualitative study.[5] Having an algorithm to follow and using equipment that

you are familiar with contribute to safer airway outcomes.[1-3,27] In the present study, an algorithm was seen neither as an established rule nor a personal action plan, which were the views found among anesthesiologists'.[11] One may speculate as to whether RNAs leave decisions on how to handle a difficult airway to the anesthesiologists, thus relinquishing their own responsibility for how to act. The RNAs' and anesthesiologists' views on algorithms were similar, in that both groups felt simplicity was needed if algorithms were to be useful in difficult airway situations, like cognitive aids for CPR. A recent simulation study supports the notion that cognitive aids can significantly reduce error rates if the professional uses simple, step-by-step pathways.[28]

Category C includes descriptions associated with several levels of competence in nursing theory, from novice to expert, as suggested by Benner.[29] In mastering nursing skills, novices learn by observing other colleagues, thereby acquiring knowledge about 'what to do.' In anesthesia practice, novice RNAs learn airway procedures, such as face mask ventilation and endotracheal intubation, by following rules and receiving valuable feedback from more experienced colleagues, thus through 'learning by doing'. They learn these skills during their first two years of practice. The value of the algorithms for novice colleagues, as regards providing rules, was expressed by RNAs in Category C.[11] According to Benner,[29] RNAs have been through a variety of difficult airway situations and 'know how' to act once they have reached the expert level, at which point they no longer rely on step-by-step rules. The experts deal with difficult situations more intuitively, rather than blindly following the procedure, and change the plan based on the patient's condition and situation, in this way avoiding actions that could potentially lead to adverse patient outcomes. The understanding captured in Category C corresponds to the expert level; the RNAs describe the need to use an algorithm with flexibility in relation to the patient and clinical situation, a skill that comes with competence and experience. For instance, no matter how well one has planned for the patient and procedures, one can always run into problems. Having a systematic way of thinking (an algorithm) and discussing the plan in advance can help in solving the problem and avoiding tunnel vision. This view has also been described by anesthesiologists[11] and confirmed in findings presented by Pierre and Nyce,[30] ie, the view that the development of expertise comes with time. One must have experienced some difficult airway situations before one can leave one's comfort zone, understand and grasp the situation at hand.

According to the RNAs in Category C, airway algorithms are useful in achieving patient safety, especially for novices. They mentioned the risk of rigidity as well, but felt it decreased with clinical experience. Handling airway problems while one is pressed for time is difficult. RNAs must maintain their vigilance and perform several demanding tasks simultaneously. A shared algorithm can make the teamwork easier and reduce the risk of mistakes. Further research is needed to determine how professionals can efficiently implement simple and flexible cognitive aids in anesthesia care.

Strengths and Limitations

The present study has several strengths. There are no previous studies on RNAs' views on difficult airway algorithms in practice, and thus the present results contribute to our understanding of this phenomenon in anesthesia care. An interview guide was developed and pilot tested to strengthen the study's credibility. Quotes from the interviews were translated and presented to exemplify the categories that emerged and to strengthen their content. To strengthen the study's trustworthiness, the co-authors who did not perform the analysis, all of whom had extensive experience of qualitative research and were familiar with the phenomenographic method, commented on the categories that emerged from the data analysis to confirm that the findings reflected the RNAs' viewpoints. The findings are likely transferable to other groups of RNAs working at anesthesia departments in Sweden, but it is up to the reader to make this determination. One limitation of the present study concerns the settings and participants. We did not ask how many RNAs worked at each hospital, which limits the generalizability of the results. In addition, the findings must be interpreted with caution owing to the small sample size. More descriptive research in this field would be valuable and could be used to enable broader generalization. Finally, 5 years have passed between data collection and the results, which may also be a limitation. However, based on our clinical experience, the findings still seem valid.

Conclusions

Airway algorithms for management of difficult airways were understood in three different ways: (1) Algorithms constitute a plan not communicated at the clinic; (2) Algorithms constitute a shared plan to improve teamwork; (3) Algorithms constitute a plan for how to think and work systematically. The RNAs expressed their desire to have a shared algorithm, and to use it as a tool during team simulations. According to the RNAs, airway management algorithms should be discussed more openly at the workplace. There is a need to strengthen RNAs' understanding of evidence-based practice and their professional responsibility for continuous learning.

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