Correlation of Medical Knowledge and Non-Technical Skills Assessment in Anesthesia Residents

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ABSTRACT

Objective: Non-technical skills training and assessment has been implemented in anesthesia residency training program to improve quality of patient care but have not been properly assessed. We hypothesized that trainees with good knowledge correlated with good cognitive parts of non-technical skills.

Methods: Seventy anesthesia residents (24 PGY-1, 24 PGY-2 and 22 PGY-3) were assessed for their knowledge by 180-item MCQs, 5 key-feature essay questions, and 18-station OSCE's. Subsequently, a perioperative anesthesia crisis situation was set up in the simulation lab for all residents and was video recorded. Non-technical skills were assessed by 2 independent trained raters using Anesthetists' Non-Technical Skills (ANTS) behavioral markers. The residents' scores were calculated to find the correlation within the ANTS rating scale.

Results: The mean scores of knowledge tests were 164.3 ±18.4 out of 300 [165.5 ±18.0, 154.7 ±16.3 and 173.6 ±16.4 for PGY-1, PGY-2 and PGY-3 respectively]. The mean scores of ANTS was divided into 4 categories (rating scale 1 to 4): task management 2.9 (±0.6), teamworking 3.0 (±0.5), situation awareness 2.9 (±0.8) and decision making 2.8 (±0.7). The knowledge test results moderately correlated with ANTS score in task management, situation awareness and decision making [r=0.382 (p<0.01), r=0.433 (p<0.001) and r=0.350 (p<0.01) respectively] and weakly correlated with the teamworking category (r=0.166, p=0.16).

Conclusion: Resident's knowledge scores showed moderate correlation with non-technical skills assessment results except teamwork. Non-technical skills are required to be trained and assessed together with knowledge to enhance the patient's safety and outcome.

Keywords: Non-technical skills; Anesthetists' non-technical skills; Assessment (Siriraj Med J 2020; 72: 483-487)

INTRODUCTION

Non-technical skills have been demonstrated to enhance performance in many medical specialties including anesthesia.[1,2] Assessment tools of non-technical skills have been developed and validated in order to facilitate teaching and learning.[3,4] The Anesthetists' Non-Technical Skills (ANTS) system contained the behavioral markers rating in 4 categories: task management, teamworking, situation awareness and decision making.[4-5]

Non-technical skills training has been implemented in anesthesia residency curriculum as part of competencies in order to improve the quality of patient care and safety.[6-8] However, non-technical skills in anesthesia have integrated with other competencies and has made it difficult to assess these separately. The assessment of non-technical skills is still limited to formative assessment along with knowledge and technical skills.

When looking closely at non-technical skills, they are divided into cognitive, analytical thinking, and social skills such as communication and teamwork.[9] Evidences suggested non-technical skills enhanced technical performances in surgical and anesthesia training.[10,11] Moreover, the interprofessional team process training improved team outcome in crisis situation without focusing on knowledge.[13,14] However, we hypothesized that trainees with good knowledge are correlated with good cognitive parts of non-technical skills.

The aim of this study was to find the correlations of knowledge assessment results and non-technical skills assessment using ANTS behavioral rating system in anesthesia residents.

MATERIALS AND METHODS

The study protocol was approved by the local ethical committee Siriraj Institutional Review Board, Bangkok, Thailand (Si 170/2015), and voluntary informed consent was obtained. Seventy anesthesia residents were assessed their knowledge at the end of the academic year by 180-item MCQs, 5 key-features essay questions, and 18-station OSCEs using the same assessment tools. Subsequently, a perioperative anesthesia crisis situation was set up in the simulation lab for all residents and video-recorded. Non-technical skills were assessed by 2 independent trained raters using Anesthetists' Non-Technical Skills (ANTS) behavioral assessment tool. This tool was translated to Thai version and found to be valid.[14] Consequently, the residents' knowledge scores were calculated to find the correlation with ANTS rating scale.

A simulation scenario was developed by researchers focusing on the Anesthetists' non-technical skills. The session was established in an operating room setting with the full-body high fidelity patient simulator (SimMan 3G; Laerdal Medical, Stavanger, Norway). The participant was individually and consecutively assigned a role of anesthesiologist in the scene of a 45-year-old female patient, previously healthy, undergoing laparoscopic myomectomy. The scenario started at the end of the procedure, after the reversal agent was given the patient developed pulseless ventricular tachycardia. The sessions were video recorded for assessment purposes.

Statistical analysis was performed using PASW Statistics version 18 (SPSS Inc., Chicago, IL, USA). The demographic data and mean scores for the knowledge test and ANTS behavioral markers were analyzed with descriptive statistics and compared between groups with one-way ANOVA. The correlations among knowledge test results and ANTS categories were calculated using Pearson's correlation. Pearson's correlation was defined

as follows: r < 0.3, weak; 0.3 < r < 0.7, moderate; r > 0.7, strong. P values of less than 0.05 were deemed to be statistically significant.

RESULTS

Seventy anesthesia residents participated in this study (24 PGY-1, 24 PGY-2 and 22 PGY-3), 12 (17.1%) were male and 58 (82.9%) were female, with mean age 29.3 ±1.6 years. The mean scores of knowledge tests were 161.9 ±20.5 out of 300 [150.7 ±19.1, 159.4 ±17.7 and 177.0 ±15.9 for PGY-1, PGY-2 and PGY-3 respectively] with significant difference between groups. The details of the scores were reported in Table 1.

The mean scores of ANTS was divided into 4 categories (rating scale 1 to 4): task management 2.9 ±0.6, teamworking 3.0 ±0.5, situation awareness 2.9 ±0.8 and decision making 2.8 ±0.7 and significantly different between groups in all categories (Table 2). The knowledge test results moderately correlated with ANTS score in all categories; task management, teamworking, situation awareness and decision making [r=0.48 (p<0.001), r=0.31 (p=0.01), r=0.54 (p<0.001) and r=0.44 (p<0.001) respectively]. The correlation of test score in PGY-1 was moderate in task management, situation awareness and decision making [r=0.31 (p=0.1), r=47, (p=0.03) and r=0.50 (p=0.02) respectively) and weakly correlated in teamwork (r=0.23, p=0.24). There was poor correlation between test scores and ANTS score in all categories for PGY-2 (task management r= -0.03, teamworking r= -0.17, situation awareness r= -0.02, decision making r= -0.09). There was strong correlation for test scores and task management in PGY-3 (r=0.71, p<0.001) with moderate correlation in situation awareness (r=0.58, p<0.01) and decision making (r=0.62, p<0.01), while there was weak correlation in teamworking (r=0.17). The details of the correlation coefficients were demonstrated in the Table 3.

DISCUSSION

Non-technical skills are divided into cognitive and social skill sets.[9] The cognitive skills of Anesthetists' Non-Technical Skills (ANTS) behavioral markers are situation awareness, decision making and task management, while the social skills are teamworking.[4] The cognitive skills of ANTS in anesthesia residents moderately correlated with the knowledge test scores and even had strong correlation with some categories in PGY-3.

Situation awareness is the first and most important step of gathering and interpreting information before making decision in complex and dynamic anesthesia clinical work.[15,16] In this study, the level of situation

TABLE 1. Knowledge test scores of PGY-1, PGY-2 and PGY-3.

Scores	Overall	PGY-1	PGY-2	PGY-3	*P* value
MCQ (100)	56.9 ±8.9	53.1 ±9.5	56.9 ±8.5	60.9 ±7.2	0.01
KFQs (100)	49.4 ±6.7	47.2 ±7.0	47.8 ±5.7	53.6 ±5.7	0.001
OSCE (100)	55.6 ±8.0	50.3 ±5.7	54.7 ±7.0	62.5 ±5.9	<0.001
Total scores (300)	161.9 ±20.5	150.7 ±19.1	159.4 ±17.7	177.0 ±15.9	<0.001

Data presented in mean ±SD
Abbreviations: ANTS, Anesthetists' Non-Technical Skills; PGY, postgraduate year; MCQ, multiple-choice questions; KFQ, Key-features questions; OSCE, objective structured clinical examination

TABLE 2. Mean score of ANTS.

ANTS category	Overall	PGY-1	PGY-2	PGY-3	*P* value
Task management	2.9 ±0.6	2.5 ±0.5	2.7 ±0.7	3.4 ±0.4	<0.001
Teamworking	3.0 ±0.5	2.7 ±0.5	2.9 ±0.5	3.3 ±0.4	<0.001
Situation awareness	2.9 ±0.8	2.5 ±0.8	2.7 ±0.6	3.6 ±0.5	<0.001
Decision making	2.8 ±0.7	2.4 ± 0.6	2.8 ±0.8	3.2 ±0.6	0.001

Data presented in mean ±SD
Abbreviations: ANTS, Anesthetists' Non-Technical Skills; PGY, postgraduate year

awareness was significantly improved in each year of training, and improved most when compared to the other categories. Also, the situation awareness was moderately correlated with all test scores. This could be due to the fact that when the trainees achieved a higher level of training, they collected more knowledge and broadened their situation awareness level. This highlighted the importance of training situation awareness together with knowledge, which occurred to be the predominant cause of anesthesia errors in critical incidence reports.[17] The ANTS behavioral markers had 3 levels of situation awareness of gathering information, recognizing and understanding, and anticipating, which can be used as a framework to facilitate teaching, giving feedback and assessing the learners during both formal training and clinical learning.[5,6]

Decision making consists of 3 elements in the ANTS behavioral rating system: identifying options, balancing risks and selecting options, and re-evaluating.[5] The scores of decision making significantly improved as the residents were in a higher level of training, which is in line with the results of situation awareness because the decision making process usually happened immediately after situation awareness.[18,19] The development of dynamic decision making in anesthesia needed the collection of mental models and knowledge for analytical thinking.[19,20] This could explain the results of moderate correlation of decision making and test scores.

Task management is defined by behaviors such as planning and preparation, prioritization, providing and maintaining standards, identifying and utilizing resources, which are noticeably knowledge based in only one element, providing and maintaining standards.[20] The results were in the same direction as situation awareness and decision making, significantly increased from PGY-1 to PGY-3 and moderately correlated with the test scores.

TABLE 3. Pearson's correlations of the overall scores, MCQ, KFQ, OSCE scores and elements of Anesthetists' non-technical skills in PGY-1, PGY-2 and PGY-3 anesthesia residents.

		All	PGY-1	PGY-2	PGY-3
Task management	Overall score	0.48[c]	0.31	-0.03	0.71[c]
	MCQ	0.37[b]	0.39	-0.05	0.54[b]
	KFQ	0.33[b]	0.07	-0.11	0.59[b]
	OSCE	0.54[c]	0.30	0.07	0.70[c]
Teamworking	Overall score	0.31[b]	0.23	-0.17	0.17
	MCQ	0.016	0.20	-0.23	-0.04
	KFQ	0.26[a]	0.24	-0.23	0.26
	OSCE	0.40[b]	0.15	0.03	0.25
Situation awareness	Overall score	0.54[c]	0.47[a]	-0.02	0.58[b]
	MCQ	0.44[c]	0.54[b]	-0.05	0.36
	KFQ	0.38[b]	0.20	-0.15	0.56[b]
	OSCE	0.58[c]	0.41[a]	0.13	0.57[b]
Decision making	Overall score	0.44[c]	0.50[a]	-0.09	0.62[b]
	MCQ	0.38[b]	0.48[a]	0.04	0.43[a]
	KFQ	0.28[a]	0.25	-0.24	0.60[b]
	OSCE	0.45[c]	0.56[b]	-0.08	0.56[b]

[a] p<0.05, [a] p,0.01, [a] p<0.001

The widely used methods for teaching and learning task management was in simulation settings due to the controllable tasks to perform.[11,12] The complex tasks can also be practiced in workplace settings in both routine and non-routine events.[21]

Teamworking is the category that the result had lowest correlation coefficient, different from the other categories, while the teamwork scores were significant improved in each level of training, the correlation with test scores was weak in all types of tests except OSCEs. This emphasized the importance of additional training and assessing of teamwork and communication, apart from knowledge and clinical training.[22] These social skills are an important part of anesthesia work in the operating theater to enhance patient safety.[23]

Moreover, the correlation of knowledge scores and level of situation awareness was different between the levels of training, moderate in PGY-1, poor in PGY-2, and moderate in PGY-3. This could be due to the improvement rate of ANTS from increasing clinical training and experiences, higher than the improvement rate of knowledge scores.

The limitation of this study was all the tests were not analyzed according to the learning objectives, which could be the mixed components of knowledge, skills and non-technical skills. Further study would be very valuable to determine the types and components of the tests to assess non-technical skills together with knowledge and technical skills. Another limitation was the lack of evidences of longitudinal development of these knowledge and skills due to the nature of this cross-sectional study that assessed at the end of the year. Time-series study would be answered the development of knowledge and competency of non-technical skills.

CONCLUSION

Residents' knowledge scores have moderate correlation with the all domain of non-technical skills assessment results, task management, teamworking, situation awareness and decision making. The category of non-technical skills that had lowest correlation coefficient was teamwork, which was poorly correlated with MCQs and KFQs, but acceptable correlation with OSCEs. Non-technical skills therefore are required to be trained and assessed together with knowledge to enhance patient safety and outcomes and cannot be assumed that residents with good medical knowledge would have good non-technical skills in all categories.

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