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The Effectiveness of Team-Based Learning in the Teaching Rounds for Standardized Training of Anesthesiology Residents

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Abstract: *This trial aimed to assess the effectiveness of the team-based learning approach on learning outcomes and evaluate satisfaction in comparison to conventional teaching rounds for anesthesiology residents. In this study, the participants were randomly assigned to two groups: the team-based learning (TBL) group (n = 40) and the conventional group (n = 40). Resident performance was measured by a multiple-choice post-class exam immediately after the teaching round. The resident satisfaction was also assessed. Post-class scores in the TBL group were significantly higher compared to the conventional group (80.25±6.79 vs 84.88±6.04, p = 0.002). Additionally, the satisfaction scores were significantly higher in the TBL group (77.75±7.83 vs 83.22±6.65, p = 0.001). This study provides evidence that team-based learning is an effective approach in teaching rounds. The findings of this study suggest that TBL can lead to better learning outcomes and higher levels of resident satisfaction compared to conventional teaching rounds.*

Keywords: *Teaching rounds, Team-based learning, Residents, Anesthesiology*

1. Introduction

In the standardized resident training program, teaching rounds are essential in training future anesthesiologists, as they offer instruction in history taking, physical examination, differential diagnosis, patient assessment, anesthesia practice strategic plan, doctor-patient interaction, teamwork, and cooperation. A conventional teaching round is a teacher-centered approach, where the teacher is the person disseminating information and the residents are passive listeners and complete the assignment according to the teacher's requirements. Students might lack the desire for active thinking and don't throw themselves into clinical practice. Their initiative has not been completely harnessed, and it is challenging to pique their curiosity and ignite their desire for learning.

The team-based learning (TBL) teaching technique, a structured form of small-group learning has become a modern pedagogy in education. In the late 1970s, TBL was originally developed. Since the early 1990s, Professor Larry Michaelsen began to use TBL in business education. Over the years, he has been devoted to the development of TBL [1-3]. TBL involves carefully formed and managed teams of students and offering them activities that need teamwork, critical thinking, and problem solving. The idea is to encourage active learning and student participation.

TBL originated in business education, but it has now gained popularity in medical and health science education globally, including medicine, pharmacy, and nursing [4-6]. TBL can be utilized in a variety of permutations and combinations across a diversity of settings, learners, and content areas [7]. TBL has a positive impact on the development of creativity, adaptability, and teamwork spirit. We hypothesize that TBL will help residents learn better during teaching rounds. This current study aimed to explore the effect of the TBL in the context of teaching rounds in standardized training.

2. Methods

2.1 Study design

This prospective randomized study was conducted at the First Affiliated Hospital of Nanjing Medical University. Anesthesiology residents in their postgraduate year (PGY) 1 to 3 were eligible to participate

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in this study. Participants were randomly allocated to a team-based learning group (TBL group) or a conventional group. Residents in both groups were randomly allocated to eight subgroups with five residents per subgroup. The same clinical cases were selected for both groups with the same instructors.

The conventional method was used for the control group, as follows: 1) Pre-class preparation (1 week in advance): pre-reading the selected cases and previewing relevant information. 2) Teaching rounds (80 minutes): one resident reported the patient's medical history and examinations, while the teachers demonstrated clinical reasoning, proposed perioperative management, and provided a comprehensive summary of the knowledge and application. 3) Close (10 minutes): facilitators summarized the case.

The TBL method was used for the intervention group, as follows [8]: 1) Pre-class preparation (1 week in advance): pre-reading the selected cases and previewing relevant information. 2) Individual readiness assurance test (IRAT) (10 minutes): residents took the test individually. 3) Team readiness assurance test (TRAT) (10 minutes): residents took the test in class with their team members. To arrive at a consensus on each answer, they discuss the questions and each other's responses. 4) Immediate feedback or clarification (10 minutes): the facilitators provide immediate feedback on team responses. 5) Clinical problem-solving activities (50 minutes): An appropriate clinical case with authentic questions based on the topic of the TBL session is provided to the class for in depth discussion in teams. All teams work on the same problems at the same time. One resident of each group reported the patient's medical history and examinations. The team discussed further diagnostic tests, determined patients' treatment plans, and proposed preliminary perioperative management. Finally, the facilitators summarized the case. Groups are encouraged to work together to problem-solve and support their responses with effective clinical reasoning. Each team is expected to contribute to the class discussion and respond to questions. 6) Close (10 minutes): Facilitators are provided with the opportunity to reflect on resident learning during the TBL session, clarifying any misunderstandings and questioning residents. Summarizing three key take-home messages or asking each team for one take-home message.

Residents in both groups were required to complete an examination immediately after the teaching round and to accept a survey of their satisfaction via an online questionnaire after class.

2.2 Outcome measures

The primary outcome was the differences in post-class quiz scores between the two groups. The examination was set at 40 minutes with a maximum score of 100 points. The secondary outcome was the residents' satisfaction. A horizontal line that is 100 mm long serves as the visual analog scale (VAS) for satisfaction. The residents marked a vertical line on the 100-mm line to indicate how satisfied he was. The number of points, ranging from 0 to 100, was equal to the millimeter measurement. The questionnaire was focused on assessing residents' experiences and opinions about the teaching modes. A 5-point Likert scale ranging from 1 to 5 (1 = absolutely disagree, 2 = disagree, 3 = no comments, 4 = agree, 5 = absolutely agree) was used for the evaluation.

2.3 Statistics

SPSS version 23 was used to analyze the results. The continuous data is mentioned as mean and standard deviation. The mean difference in total quiz scores between different strategies used by both groups was calculated using Student's t-test. Categorical data is presented as frequency. The Pearson's chi-squared or Fisher's exact test was used to analyze feedback data. $P < 0.05$ was considered as level of significance.

3. Results

We compared the TBL and conventional groups' post-class quiz scores and found that the scores were significantly higher in the TBL group than in the conventional group ($P < 0.05$). Additionally, in the TBL group, the satisfaction scores were significantly higher than those in the conventional group ($P < 0.05$) (Table 1).

Table 1: Post-class quiz and residents' satisfaction scores in the TBL and conventional groups

	TBL group	**Conventional group**	**P-value**
Post-class quiz scores	84.88±6.04	80.25±6.79	0.002
Satisfaction scores	83.22±6.65	77.75±7.83	0.001

Using the questionnaire (Table 2), the variation of answers reinforced the interest and satisfaction of

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residents in the TBL group by the dynamics of the method. Residents in the TBL group highlighted positive points such as: I think that the teaching mode helps me increase my understanding of the course material. (100%); I believe my ability to collaborate with my peers has improved (100%).

Table 2: A questionnaire assessing residents' experiences and opinions about the teaching modes in the TBL and conventional groups.

Questionnaire	TBL group		Conventional group	
	1 to 3	4 to 5	1 to 3	4 to 5
1) I think that the teaching mode makes learning interesting.	12 (30.0%)	28 (70.0%)	27 (67.5%)	13 (32.5%)
2) I think that the teaching mode helps me increase my understanding of the course material.	NA	40 (100%)	12 (30.0%)	28 (70.0%)
3) I believe that the teaching mode was helpful in developing my information synthesizing skills.	9 (22.5%)	31 (77.5%)	23 (57.5%)	17 (42.5%)
4) I believe that my critical thinking skills are improved.	12 (30.0%)	28 (70.0%)	18 (45.0%)	22 (55.0%)
5) I accept that I paid attention most of the time and most residents were attentive during teaching rounds.	6 (15.0%)	34 (85.0%)	14 (35.0%)	26 (65.0%)
6) I am responsible for my own learning and supporting my peers' learning.	12 (30.0%)	28 (70.0%)	27 (67.5%)	13 (32.5%)
7) I believe my ability to collaborate with my peers has improved.	NA	40 (100%)	26 (65.0%)	14 (35.0%)
8) I can get immediate feedback and improvement.	10 (25.0%)	30 (75.0%)	33 (82.5%)	7 (17.5%)
9) In general, I can say I enjoyed the teaching mode.	6 (15.0%)	34 (85.0%)	21 (52.5%)	19 (47.5%)
10) I hope to continue to use this approach in future teaching rounds.	11 (27.5%)	29 (72.5%)	34 (85.0%)	6 (15.0%)

4. Discussion

As opposed to conventional teaching rounds of passively listening to a lecturer's presentations, TBL is an innovative teaching and active learning strategy. TBL, as pushed by the US Department of Education Fund, has long been employed in US and international schools. As a novel medical pedagogical strategy, TBL has been increasingly introduced into Chinese medical education programs in recent years. In our study, residents in the TBL group achieved better results compared to the conventional group. These data corroborate the hypothesis of the study in this aspect. TBL improves academic achievement, communication skills, and clinical outcomes in medical education [9]. When compared to conventional lecture-based learning, it also increases engagement, motivation, and satisfaction. It is characterized by four key elements: (1) Groups. Groups should be effectively organized and managed. (2) Accountability. Residents are responsible for both their individual effort and teamwork. (3) Feedback. Residents ought to be provided with instant, frequent, and constructive feedback. (4) Assignment. Designing team projects that foster team development and learning [10].

In this study, residents showed good acceptance of the method and hoped to continue to use this approach in future teaching rounds. They highlighted positive points such as: I think that the teaching mode helps me increase my understanding of the course material. (100%); I believe my ability to collaborate with my peers has improved (100%). TBL requires residents to acquire foundational knowledge prior to class by completing clear instructor-developed unit objectives, advanced preparation assignments, and readiness assessments. Most residents participating in TBL in our study prepared outside of class before the in-class sessions; thus, they were prepared to actively engage in the class. TBL creates a more interactive and engaging learning environment. By working in teams, residents have the opportunity to discuss and debate ideas, share their knowledge, and learn from each other. This collaborative approach helps residents pay attention during teaching rounds, deepen their understanding of the subject matter, and develop information synthesizing skills. It also promotes accountability and responsibility. Each team member is responsible for their own learning as well as the learning of their

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team. This encourages residents to be more engaged and motivated and also helps to develop their leadership and teamwork skills.

5. Conclusion

The results of this study provide evidence that team-based learning is an effective approach in teaching rounds. The findings of this study suggest that TBL can lead to better learning outcomes, and higher levels of resident satisfaction compared to conventional teaching rounds. However, further research is needed to explore the long-term effects of TBL on learning outcomes and to identify best practices for implementing TBL.

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