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Original Article

Application of distant live broadcast in clinical anesthesiology teaching

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Abstract: Objective: To explore the application value and effect of distance live broadcast in Clinical Anesthesiology teaching. Methods: Undergraduate students of year 2017 who majored in Anesthesiology at the Wannan Medical College (China) were chosen as the study subjects. According to the different teaching methods, the students were divided into two groups: 59 in the traditional teaching group (control group) and 61 in the traditional teaching combined with distant live broadcasting teaching group (observation group). The teaching feedback, students' satisfaction, and the theory and skill scores of the course were compared between the two groups. Results: The teaching feedback in the observation group was better than that in the control group ($P<0.05$). The students' satisfaction rate with teaching and the theory and skill learning score in the observation group were higher than those of the control group ($P<0.05$). Conclusion: Traditional teaching combined with distant live broadcast teaching has achieved good results in clinical anesthesiology teaching, improved the overall quality of teaching, and has high clinical teaching value.

Keywords: Distant live broadcast, clinical anesthesiology, teaching feedback, reform in education

Introduction

With the progress of the times and the rapid changes in science and technology, modern information technologies, such as Internet, cloud computing and big data, have profoundly changed people's way of thinking, production, life, and learning [1]. The development of information technology has made break-throughs in "time and space limit" in education, which is an effective way to narrow the educational gap and promote educational equity. Educational informatization promotes the "double revolution" of teaching and learning, and is an important means to share high-quality education resources and improve education quality [2, 3]. At the same time, influenced by COVID-19, school education has been greatly impacted. Network teaching is a new and effective teaching mode.

Although multimedia teaching has been routinely used, they are all static contents and can not realize real-time dynamic scene display. Due to the lack of clinical knowledge, it's difficult for students to observe clinical teaching contents intuitively, dynamically, and in real time, which affects the quality of clinical theory teaching and is not conducive to students' understanding of corresponding theoretical knowledge [4, 5].

Clinical anesthesiology is a comprehensive discipline integrating clinical anesthesia, life function regulation, intensive monitoring and treatment, and pain diagnosis and treatment. At present, the teaching of Clinical anesthesiology is still dominated by teacher-assisted multimedia teaching. Students learn the knowledge passively, which seriously affects the learning efficiency [6, 7].

The distant live broadcasting system relies on advanced digital image processing technology and digital network technology. Relying on high-speed network and high-definition video equipment, the anesthesia operation process can be broadcasted and observed in real time; more-

over, the whole process can be recorded in high-definition and replayed on demand. The high-definition operating room video teaching system enables high-definition audio and video interaction, live broadcast, and data signal network transmission [8]. In the later stage, by accessing the national ultra-high definition telemedicine and health special network based on video networking technology, we can conduct remote interaction and training, and provide powerful system management functions to meet the needs of remote teaching and discussion [9]. This technology has carried out two-way video and audio transmission between the meeting site and the operation room in a variety of academic seminars to realize distance teaching interaction, and the effect has been affirmed [10]. The distant teaching system can realize the separation of students from the operating room, avoid the interference of on-site observation on surgeons, keep the operating room clean, and reduce the incidence of infection [11].

This study explored the application value of distant live broadcast on the clinical anesthesiology teaching.

Materials and methods

General data

A total of 120 undergraduates (Year 2017) majored in Anesthesiology of Wannan Medical College were selected as the research objects. There were 56 males and 64 females with an average age of 21-23 years old. According to the teaching methods, the subjects were divided into two groups: traditional teaching group (control group, 29 males and 30 female) and traditional teaching combined with distance live broadcast teaching group (observation group, 27 males and 34 females). The teachers were from the Department of Anesthesiology, the First Affiliated Hospital of Wannan Medical College, with the title of vice senior or above, and have been engaged in clinical teaching for more than 10 years.

Methods

In the control group, the traditional teaching methods were used. Clinical Anesthesiology (4th Edition) was used as the blueprint, and the lessons were prepared according to the syllabus before class to explore the key and difficult points of teaching. In the class, teachers taught theoretical knowledge and clinical demonstration, and then arranged students to operate on the corresponding models. In class, multimedia teaching was combined and analyzed with pictures and texts. After class, the students summarized and reviewed the key and difficult points.

In the observation group, distant live broadcasting was applied. Before class, teachers in both classroom and the operation room prepared lessons collectively in advance. The live coverage of the operating room was shown on the screen in the class room by using the distant live broadcasting system. The teachers in the classroom were the key speakers who explained the course content as planned, and the teachers in operation room showed the clinical operation in real time, and appropriately interspersed the front-end real-time communication and interaction. After class, teachers summarized and reviewed the key and difficult points and reflected on the content of the course (**Figure 1A**).

At the end of each course, the two groups had a brief “flipped class”, to briefly describe their mastery of knowledge, and an examination was organized at the end of the course. The specific teaching methods are shown in **Figures 2** and **3**. **Figure 2** shows the teachers performing anesthesia in the operating room and the distant live broadcasting system. **Figure 3** shows the teachers explaining the details and basic theory of the anesthesia for students in the classroom.

All study subjects signed the informed consent.

Distant live broadcasting system

The distant live broadcasting system was built by Yijishan Hospital Affiliated to Wannan Medical College and the School of Anesthesiology of Wannan Medical College. As a platform for anesthesia teaching and two-way communication, it could share real time high-definition broadcasting of the practices in the operating room with the students in classroom, which is beneficial to practical teaching.

With the distant teaching system, the practice in the operating room and teaching in classroom were transmitted synchronously to both

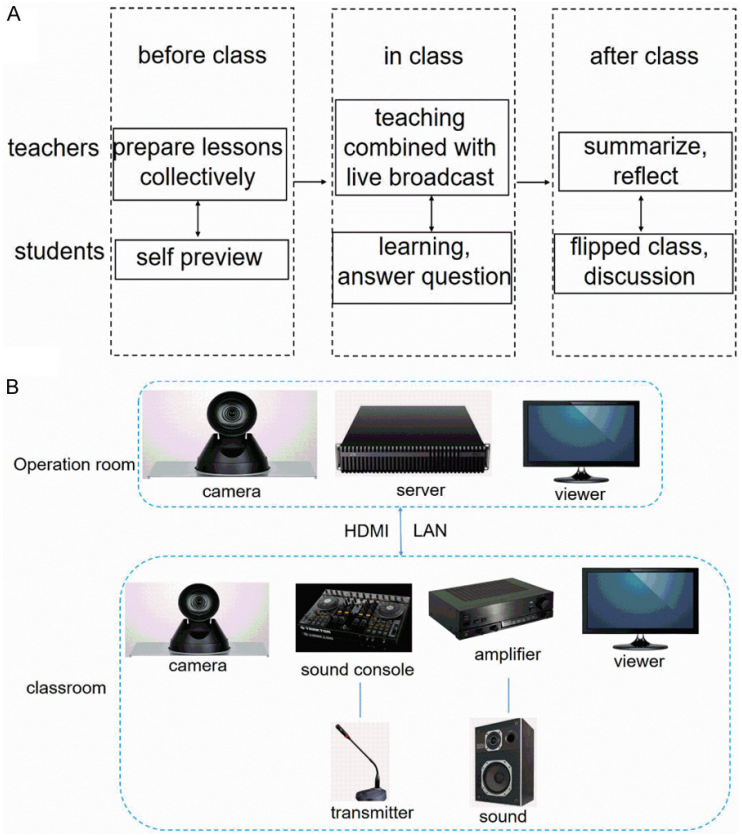

Figure 1. Schematic illustrates distant live broadcast system in detail. A: Live broadcast teaching model of students and teachers; B: Configuration of live broadcast teaching system.

Figure 2. Distant live teaching in operation room.

sites, so as to realize the real-time interaction between classroom and the operating room to make the quality of classroom teaching better. See **Figure 1B** for details.

The distant teaching system consisted of terminal system, transmission system and control management system. The terminal system consisted of video and audio acquisition equipment, encoding and decoding equipment, video and audio output equipment and display and playback equipment; The transmission system was composed of network cable, optical fiber, access layer switch, convergence layer switch, etc. The control management system consisted of various types of servers, platform software, storage devices, and client computers.

① Terminal system equipment included: high-definition (HD) camera, microphone, HD display screen, operation room HD terminal, classroom HD terminal, etc. After the collection of video, audio, data, instructions and other signals, the information were processed to form a composite digital code stream, which was further converted into a signal format compatible with the user network interface and in line with the provisions of the transmission network, and then transmitted to the specified receiver through the channel.

② The transmission system was based on video networking technology. The transmission subsystem was responsible for the transmission of video and audio signals and control signals, which was mainly based on video. The transmission subsystem has full HD video transmission capacity and low delay transmission effect, and supports wired transmission mode, wireless transmission mode and 5G network transmission.

③ The control management system was the core subsystem of the distant live broadcasting system. It was composed of a core server, unified video integrated management platform,

Figure 3. Distant live broadcasting in classroom and operation room. A: Distant live broadcasting in classroom; B: Distant live broadcasting in the operating room.

content management system, recording and broadcasting server, network storage, and monitoring and broadcasting service system. It was a subsystem that realized the functions of control, scheduling, management and query of audio and video information. It could centralize various data, high-quality voice, high-quality video, multimedia, communication and management functions on one platform for unified implementation and management.

Observation indicators

(1) The mastering of theoretical knowledge and skill performance of students. Miller's Pyramid was used to assess the clinical competence of the students. It is comprised of four tiers: knowledge, competence, performance, and action. The examinations on theory and practice skill were conducted one week after the end of the course (100 points in total), which was evaluated by teachers who had not participated in this study. Theoretical examination was in the form of multiple-choice questions (MCQ) with a full score of 100 points. The examination was carried out and evaluated in both groups at the same time with a unified standard. Practice skill examination was in the form of mini-clinical evaluation exercise (Mini-CEX) and structured short answer questions. The full score of the test was 100 points covering 5 operations with 20 points for each, including the operation standard of general anesthesia, central venous puncture, arterial puncture, epidural anesthesia and the hospital cardiopulmonary resuscitation.

(2) Clinical teaching feedback: Students filled in and submitted the teaching feedback questionnaire after each class. In combination with the actual situation of our school, a teaching feedback working group was constructed with the director of the teaching and research office as the team leader and the teaching secretary as the team members, and the evaluation mechanism of the teaching and research office was established. The teaching feedback form was adjusted by adding students' feelings, understanding and views on the teaching modality into the scoring items to ensure the refinement and objectivity of the score, so as to ensure a fair evaluation of the teaching work. After each class, a feedback questionnaire was issued to the students to participate in the evaluation. Finally, the learning committee input and sorted out the feedback information and arranged it according to the score nodes. The scoring standard: over 90 points indicated excellent, 80~89 points indicated good and lower than 80 points represented poor.

(3) Teaching satisfaction: The students filled out the questionnaire anonymously after a semester. The questionnaire included 6 questions about students' satisfaction on the teaching methods: Whether the modality aroused the interest in learning? Whether the modality deepened the understanding of learning content? Was there a comfortable atmosphere? Did the modality integrate theory with practice? Whether the modality could improve clinical skills, and enhance learning efficiency? The score over 90 represented satisfaction, 60~90 represented partial satisfaction, and less than 60 represented dissatisfaction.

Statistical analysis

All analyses were performed using SPSS 22.0 and Graphpad prism 7.0 software. All continu-

Table 1. Comparison of general performance between the two groups

	Control Group (n=59)	Observation group (n=61)	X^2	P
Excellent (≥90)	6	8	2.34	0.673
Good (80~89)	21	18		
Secondary (70~79)	18	24		
Pass (60~69)	12	8		
Fail (<60)	2	3		

Table 2. Teaching feedback of two groups

Teaching feedback	Observation group (n=61)	Control Group (n=59)	X^2	P
Excellent	48 (78.69%)	33 (55.93%)	8.036	0.018
Good	11 (18.03%)	18 (30.51%)		
Bad	2 (3.28%)	8 (13.56%)		

Table 3. Comparison of teaching satisfaction

Group	n	Satisfied	Partial satisfied	Not satisfied
Control group	59	40 (67.80%)	15 (25.43%)	4 (6.77%)
Observation group	61	55 (90.16%)	5 (8.20%)	1 (1.64%)
X^2			9.138	
P			0.0104	

Table 4. Comparison of examination results between the two groups

Group	n	Score of theory	Scores of skills
Control group	59	85.22±5.33	74.26±4.59
Observation group	61	94.52±3.48	87.29±4.28
t		11.35	16.09
P		<0.001	<0.001

ous variables were expressed as mean ± standard deviation ($\bar{x}$±sd), and independent sample t-test was used for comparison. Counted data were expressed as rate (%), and χ^2 test was used for comparison. P<0.05 was considered significant.

Results

General performance of the two groups of students

There was no statistical difference between the two groups of students in general performance (P>0.05), indicating comparability. See **Table 1**.

Teaching feedback

The teaching feedback questionnaire of all students was collected. The teaching feedback of the observation group was better than that of the control group. 78.69% of the students in the observation group thought the teaching modality was excellent, compared with 55.93% of the students in the control group. The difference was statistically significant (P<0.05). See **Table 2** for details.

Students' satisfaction

The satisfaction rate in the observation group was significantly higher than that in the control group, indicating that the combined teaching modality outperformed the traditional teaching modality in arousing students' interest in learning, deepening the understanding of learning content and creating a comfortable clinical teaching atmosphere (P<0.05). See **Table 3**.

Assessment of clinical anesthesiology between the two groups

As shown in **Table 4** and **Figure 4**, the average scores of examination on anesthesia theory and practical skills of the students in the observation group were significantly higher than those in the control group (<0.001).

Discussion

Clinical anesthesiology is a comprehensive discipline, involving multiple clinical subjects such as Surgery, Internal Medicine, Obstetrics and Gynecology, Pediatrics and so on [7, 12]. The traditional teaching methods of clinical anesthesiology are depending on teachers who instill abstract concept into students, supplemented by multimedia technology. Students have low interest in learning, which directly affects learning efficiency and ability to analyze and solve problems [13]. How to effectively improve the teaching quality has become the focus of current teaching reform [14].

Distant live broadcast creates a teaching environment in which students can not only simply learn theories, but also exercise the medical related skills and teamwork in the face of real

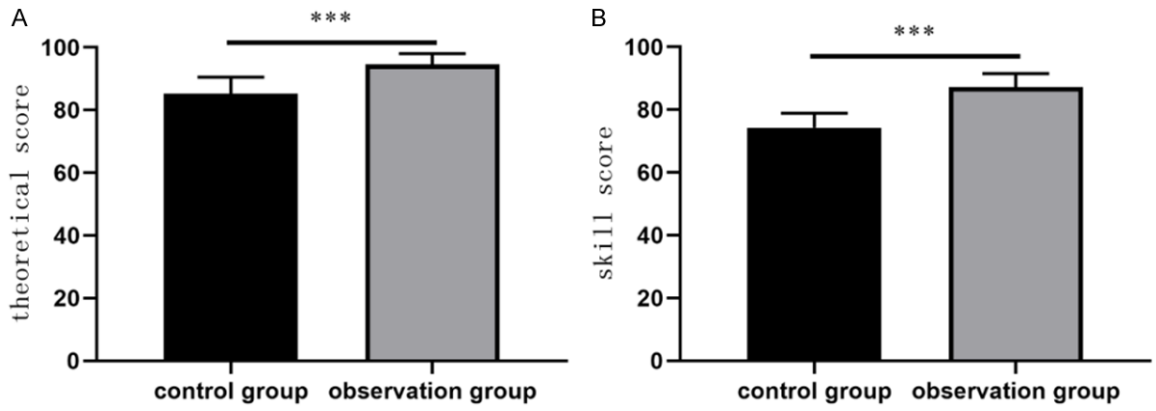

Figure 4. Comparison of examination results between the two groups. Note: ***indicates P<0.001 vs control group.

clinical problems. Distant live broadcast is based on network platform to provide convenience for students to learn online more flexibly, which is of great significance for learning and teaching this course [15, 16]. The application of this technology in teaching improves communication between teachers and students, deepens students' understanding of abstract concepts, theories and principles, which is indispensable for students to enter into a higher phase of learning in the future [17]. At present, the distant live broadcast has been applied to medical teaching, such as guiding medical treatment, diagnosis and treatment procedures, which is a good channel for medical students and health workers to obtain medical knowledge [18-20].

Teaching feedback is one of the important means to reflect teaching quality [21]. Some studies demonstrated better teaching efficacy with a higher feedback score [22]. In this study, we found that teaching feedback of the observation group was better than that in the control group. Michael Co et al. showed students involved in his pilot study had undergone both face-to-face teaching and the new web-based training and most of them see this new method as a good replacement to real-time face-to-face surgical skill training during the COVID-19 pandemic, which is consistent with ours [23].

This study showed that the teaching satisfaction in the observation group was significantly higher. Distant live broadcast is a novel form for students, which can arouse the students' interest in learning, transforming abstract concept into practice in real time through audio. It can deepen the understanding of concept and also integrate theory with practice, and thus improve clinical skills of students at the same time. It creates a comfortable atmosphere for teaching. All the above factors can improve learning efficiency certainly. Liang Yu et al. also showed that most students are very satisfied with the live broadcast teaching modality [24].

The study of Huang et al. indicated that Miller's Pyramid assessment scale could measure the competency development of medical students with good reliability and structural validity [25]. In this study, we found that the score on anesthesia theory and practice skill of students assessed by Miller's Pyramid assessment scale in the observation group was significantly higher, which is probably because the students in observation group not only mastered the theory effectively, but also know how to use the knowledge into practice, and what's more, they know how to better perform when facing a patient clinically.

However, there are still some shortcomings in this study. For example, the research subjects are only the senior grade students, and there is no classified research on the primary, middle, senior grades. We will study the impact of live broadcast teaching modality on the teaching effect and the specific influencing factors of this teaching mode for the primary, middle and senior grade students in the future.

In short, the application of distant live broadcasting in teaching Clinical Anesthesia to undergraduate students has obvious effect, which is the embodiment of the reform of teaching methods. It can better combine theory and practice, play an important role in stu-

dents' mastering clinical anesthesiology knowledge and improving clinical skills. At the same time, it can improve the students' subjectivity in learning and improve the overall quality of teaching.

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Disclosure of conflict of interest

None.

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