Journal of Contemporary Educational Research, 2024, Volume 8, Issue 6
http://ojs.bbwpublisher.com/index.php/JCER
ISSN Online: 2208-8474
ISSN Print: 2208-8466

Application Effect of Remote Ultrasound Teaching in Standardized Residency Training

Weixia Kong, Qing Yang, Ying Zhou, Qi Guo*

The Fifth Affiliated Hospital of Zhengzhou University, Zhengzhou 450052, Henan Province, China

***Corresponding author:** Qi Guo, 13783531872@163.com

Abstract: *Objective:* To explore the application effect of remote ultrasound teaching in the standardized training of residents. *Methods:* 42 students who participated in the standardized residency training in the Department of Ultrasonography of our hospital from August 2022 to August 2023 were selected and divided into the control group (n = 21) and the observation group (n = 21) by using the random number table method. The control group was taught routinely, and the observation group was taught with remote ultrasound on the basis of the control group. The general data, teaching effect, ultrasound diagnostic compliance rate, and teaching satisfaction of the participants in the two groups were observed. *Results:* The baseline data of the two groups were not statistically significant ($P > 0.05$); the theoretical and practical assessment scores of the observation group were significantly better than those of the control group ($t = 2.491$, $t = 2.434$, $P = 0.05$); the ultrasound diagnostic compliance rate of the participants in the observation group was significantly higher than that of the control group (78.33%) ($\chi^2 = 33.574$, $P = 0.000 < 0.001$); the overall satisfaction rate of students in the observation group (20/95.24%) was significantly higher than that of the control group (14/66.67%) ($\chi^2 = 3.860$, $P = 0.049 < 0.05$). *Conclusion:* In standardized residency training, remote ultrasound teaching can effectively improve the comprehensive ability of students, enhance diagnostic accuracy, and improve students' teaching satisfaction.

Keywords: Remote teaching; Ultrasound; Resident; Standardized training; Application effect

Online publication: July 5, 2024

1. Introduction

With the continuous progress of medical technology and the increasing clinical demand, ultrasound medicine is becoming more and more prominent in clinical medicine. As a non-invasive, real-time, intuitive imaging diagnostic technology, ultrasound medicine plays an irreplaceable role in the diagnosis, treatment, and monitoring of diseases [1]. However, the traditional way of teaching ultrasound medicine is limited by time, place, and resources, which leads to many challenges in the standardized training of residents [2]. Therefore, exploring new teaching methods to improve the teaching effectiveness and efficiency of ultrasound medicine has become an important issue in the field of medical education. In recent years, remote ultrasound teaching has gradually received attention for its unique advantages. Based on modern information technology, remote ultrasound teaching achieves remote teaching and practical operation of ultrasound medical knowledge through

the network platform. It breaks the time and space limitations of traditional teaching and enables residents to learn anytime and anywhere, thus improving learning efficiency and effectiveness. At the same time, remote ultrasound teaching can also make full use of high-quality teaching resources to achieve resource sharing and promote the balanced development of ultrasound medical education. In this context, the purpose of this paper is to explore the application effect of remote ultrasound teaching in standardized residency training in order to provide useful references and guidelines for future ultrasound medical teaching and to contribute to the cultivation of more excellent ultrasound medical talents.

2. General information and methods

2.1. General information

42 residents who participated in the standardized residency training in the Department of Ultrasonography of our hospital from August 2022 to August 2023 were selected and divided into the control group (n = 21) and the observation group (n = 21) by using the random number table method. Inclusion criteria: (1) trainees undergoing standardized residency training; (2) voluntary participation in the study and agreement to undergo training and related assessment by the remote ultrasound teaching system. Exclusion criteria: (1) trainees who do not meet the status or qualifications for standardized residency training; (2) trainees who are unable or unwilling to undergo the training and assessment of the remote ultrasound teaching system due to physical reasons, work reasons, or other personal reasons.

2.2. Methods

The control group adopted routine teaching. The instructor used the courseware to explain the theoretical knowledge and then demonstrated the operation on the machine, and the trained physicians observed and learned. They practiced in groups at the end of the study and the theoretical and practical assessments were carried out after the completion of the practice.

The observation group received remote ultrasound teaching on the basis of the control group, as described as follows.

(1) Remote ultrasound theoretical lectures: Teachers relied on remote teaching platforms to conduct ultrasound basic theoretical lectures through online live broadcasts, video recordings, and other forms of ultrasound, the content covered the physical basis of ultrasound, principles of ultrasound examination, ultrasound equipment operation skills, ultrasound image interpretation of common diseases, and other aspects of ultrasound, so that residents could fully grasp the basic theory, principles, and clinical application of ultrasound. In the course of lectures, teachers should focus on the combination of theory and practice, and help trainees understand the characteristics of ultrasound images and diagnostic ideas through abundant cases and image materials [3]. At the same time, teachers also actively interacted with residents through online Q&A, group discussion, and other ways to answer residents' questions and improve their participation and learning effect.

(2) Remote ultrasound practice guidance: After the students were familiar with the theoretical knowledge and passed the examination, they carried out clinical practice operations. Relying on the remote teaching platform, students independently carried out ultrasound examinations on the machine, and the teacher remotely observed and guided the students' operation techniques in real time through the teacher's remote port, corrected the students' incorrect operation in time, and helped the students to master the correct operation methods and techniques. After the completion of the practice, the results of the operation were reviewed to ensure that the results were accurate.

(3) Remote ultrasound diagnostic consultation: When the students were unable to complete the diagnosis during the operation due to various reasons, they could initiate a remote ultrasound consultation request from the student port to seek guidance from the teacher. After accepting the consultation request, the teacher sorted out the problems in the operation process of the students and guided them correctly.

2.3. Observation indicators

(1) Basic information: Gender, average age, and academic qualifications.

(2) Teaching effect: Theoretical examination results and practical examination results, each with a total score of 50 points.

(3) Ultrasound diagnostic compliance rate: Among the ultrasound reports with pathological or clinical diagnosis results, 20 ultrasound reports were taken from each student, totaling 840, and the ultrasound diagnostic compliance rate was assessed based on pathological or clinical diagnosis results.

(4) Teaching satisfaction: This was divided into "very satisfied," "satisfied," and "dissatisfied." Comprehensive satisfaction rate = (Number of very satisfied cases + number of satisfied cases) / Total number of cases × 100%.

2.4. Statistical methods

Statistical processing was carried out using SPSS20.0, measurement data using mean ± standard deviation (SD); and comparison between groups using the two-sample *t*-test and χ^2 test; $P < 0.05$ indicated a statistically significant difference.

3. Results

3.1. Comparison of basic information of patients in the two groups

As shown in **Table 1**, the baseline information of the two groups of patients was not statistically significant ($P > 0.05$).

Table 1. Comparison of basic information of patients in the two groups

Groups	Gender (male/female)	Average age	Academic qualifications (Master's degree and above / Bachelor's degree)
Control group ($n = 21$)	8/13	27.65 ± 2.41	5/16
Observation group ($n = 21$)	9/12	27.73 ± 2.46	4/17
χ^2/t	0.099	0.0107	0.000
P	0.753	0.916	1.000

3.2. Comparison of the teaching effect of the two groups

The observation group's theoretical assessment scores and practical assessment scores were significantly better than those of the control group ($t = 2.491$, $t = 2.434$, $P < 0.05$ for all), as presented in **Table 2**.

Table 2. Comparison of the teaching effect of the two groups

Groups	Theoretical assessment results	Practical examination results
Control group ($n = 21$)	41.56 ± 6.21	40.38 ± 6.24
Observation group ($n = 21$)	46.89 ± 7.59	45.82 ± 8.12
t	2.491	2.434
P	0.017	0.020

3.3. Comparison of ultrasound diagnostic compliance rate between the two groups

Based on **Table 3**, the ultrasound diagnostic compliance rate of students in the observation group (88.81%) was significantly higher than that of the control group (78.33%) ($\chi^2 = 33.574$, $P = 0.000 < 0.001$).

Table 3. Comparison of ultrasound diagnosis compliance rate between the two groups

Groups	Number of ultrasound diagnostic compliance reports	Ultrasound diagnostic compliance rate (%)
Control group	658	78.33
Observation group	746	88.81
χ^2	33.574	
P	0.000	

3.4. Comparison of teaching satisfaction between the two groups

As shown in **Table 4**, the overall satisfaction rate of the students in the observation group (20/95.24%) was significantly higher than that of the control group (14/66.67%) ($\chi^2 = 3.860$, $P = 0.049 < 0.05$).

Table 4. Comparison of teaching satisfaction between the two groups

Groups	Very satisfied	Satisfied	Dissatisfied	Comprehensive satisfaction rate (%)
Control group ($n = 21$)	6 (28.57%)	8 (38.10%)	7 (33.33%)	14 (66.67%)
Observation group ($n = 21$)	15 (71.43%)	5 (23.81%)	1 (4.76%)	20 (95.24%)
χ^2			3.860	
P			0.049	

4. Discussion

Ultrasound medicine is an essential branch in the field of modern medicine, which uses the propagation, reflection, refraction, absorption, and other characteristics of ultrasound waves in human tissues to achieve non-invasive examination and evaluation of the internal structure and function of the human body. Ultrasound medicine is highly practical, which also puts forward higher requirements for ultrasonographers [4]; for this reason, standardized training is a vital part of the process in order to ensure that residents are able to comprehensively master the clinical knowledge, skills, and professionalism, and to provide high-quality healthcare services to patients [5,6].

Through systematic training and clinical practice, residents can gradually accumulate experience, improve their clinical decision-making ability and teamwork, and lay a solid foundation for future career development. However, there are some challenges in the current standardized residency training. As far as traditional ultrasound teaching is concerned, it mainly relies on live demonstrations and explanations by teachers, while students learn through observation and practice. There are some obvious disadvantages of this approach, such as limited teaching resources, single teaching mode, etc. For this reason, the advantages of remote ultrasound teaching are highlighted.

Remote ultrasound teaching refers to teaching activities that use modern information technology, such as the Internet, audio, and video transmission equipment, etc., to teach ultrasound medical knowledge, skills, and practical experience to remote learners. With the rapid development of medical technology and the increasing tension of medical education resources, remote ultrasound teaching, as a new type of education mode, has

gradually been widely used and promoted [7]. It can not only effectively solve the problems of geographical limitation and uneven distribution of resources, but also improve the popularity and accessibility of ultrasound medical education and cultivate more medical talents with ultrasound medical knowledge and skills.

In this study, the theoretical assessment scores and practical assessment scores of the observation group were significantly better than those of the control group ($t = 2.491$, $t = 2.434$, $P_{all} < 0.05$). It indicates that compared with traditional ultrasound teaching, remote ultrasound teaching can improve the comprehensive ability of the students. Firstly, remote ultrasound teaching breaks through geographical limitations, so that high-quality ultrasound teaching resources can be widely shared, and students, regardless of where they are, can obtain the latest ultrasound medical knowledge, skills, and practical experience through the network, thus broadening their learning horizons and improving their learning efficiency; secondly, the remote ultrasound teaching platforms are usually equipped with real-time interactive tools, such as online discussion forums and real-time Q&A, which enable students to communicate and discuss with teachers and other students instantly, and this interactive teaching method helps to stimulate students' interest in learning and improve their learning motivation. In addition, remote ultrasound teaching is usually combined with case analysis, simulation operation, and other practical aspects, which provides more practical opportunities for students, who can familiarize themselves with the operation skills of ultrasound equipment through simulation operation, and exercise their diagnostic skills through case analysis, thus continuously improving their comprehensive ability in practice.

This study also pointed out that the compliance rate of ultrasound diagnosis of the observation group (88.81%) was significantly higher than that of the control group (78.33%) ($\chi^2 = 33.574$, $P = 0.000 < 0.001$), which indicates that remote ultrasound teaching can effectively improve the accuracy of ultrasound diagnosis. Remote ultrasound teaching relies on the distance learning platform, which provides students with richer and more comprehensive learning resources, through which students can come into contact with more ultrasound diagnosis cases and learn the ultrasound performance and treatment of different cases. This diverse learning experience helps students broaden their diagnostic ideas and improve the accuracy of diagnosis [8]. At the same time, when students are performing practical operations, teachers can provide real-time guidance through the distance learning platform, and after students' operations, teachers will also review students' reports, coupled with remote ultrasound consultation, which can effectively improve the accuracy of diagnosis [9].

This study also found that the overall satisfaction rate of students in the observation group (20/95.24%) was significantly higher than that of the control group (14/66.67%) ($\chi^2 = 3.860$, $P = 0.049 < 0.05$), which indicates that remote ultrasound teaching can effectively enhance students' satisfaction with teaching. Remote ultrasound teaching breaks through geographical limitations so that students can receive high-quality ultrasound education no matter where they are, and this flexibility greatly meets the individual needs of students, enabling them to study according to their own schedule and learning progress, thus enhancing learning efficiency and satisfaction. Secondly, remote ultrasound teaching usually adopts advanced online education platforms and interactive tools, which provide teachers and students with a rich variety of teaching means and communication methods. For example, through real-time video, audio, and text exchanges, students can instantly ask questions, participate in discussions, and receive timely feedback and guidance. This high degree of interactivity enhances students' learning engagement and satisfaction [10].

5. Conclusion

In summary, remote ultrasound teaching in standardized residency training can effectively strengthen students' comprehensive ability, enhance diagnostic accuracy, and enhance students' teaching satisfaction.

Funding

Zhengzhou University Academy of Medical Sciences Graduate Education Reform Research and Curriculum Construction Project (Project number: 040012023B059)

Disclosure statement

The authors declare no conflict of interest.

References

[1] Zhu L, Fei X, Li Q, et al., 2023, The Application of Remote Ultrasound Teaching in the Standardized Training of Residents. China Continuing Medical Education, 15(24): 123–127.

[2] Li K, Wu S, Ren X, 2021, Exploration of the Application of 5G Technology in Ultrasound Medicine Distance Teaching. Medical Theory and Practice, 34(21): 3851–3853.

[3] Yu F, Wang J, Ye X, et al., 2019, Preliminary Design and Application of Ultrasound Distance Learning Platform Based on Multi-System Fusion. Education and Teaching Forum, 2019(13): 60–62.

[4] Yong Q, 2015, PBL Teaching Combined with Ultrasound Simulation System and Remote Monitoring System in Ultrasound Teaching. Continuing Medical Education, 29(03): 29–30.

[5] Fei X, Han P, Liang S, et al., 2020, Application of Ultrasound Quality Control System in Standardized Training of Ultrasound Residents. Chinese Journal of Medical Education, 40(12): 1019–1022.

[6] Lin ZM, Hong YR, Liu CM, Et Al., 2022, PBL Teaching In Ultrasonography Resident Standardization Training in the COVID-19 Pandemic. BMC Med Educ, 22(1): 512.

[7] Chen R, Zhao J, 2019, Preliminary Application of Real-Time Remote Teaching System Based on Intelligent Portable Color Ultrasound Cloud Technology in the Practical Teaching of Diagnostic Ultrasonography. Journal of Clinical Ultrasound Medicine, 21(04): 309–311.

[8] Gao L, He J, Wang B, 2022, Practice and Supervision and Management of Telemedicine Education Oriented to Active Health Needs. China Continuing Medical Education, 14(23): 112–116.

[9] Wang C, Zheng Y, Xiong C, et al., 2022, Preliminary Exploration of Theory and Practice Training of 5G Ultrasonic Remote Consultation in Grassroot Hospitals. BMC Health Ser Res, 22(1): 817.

[10] Cui K, He H, 2022, Application of Blended Teaching Mode in Pediatric Clinical Teaching. Education and Teaching Forum, 2022(28): 147–150.