PBL Teaching In Ultrasonography Resident Standardization Training In The COVID-19 Pandemic

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Abstract

Objective: To study the effect of problem-based learning (PBL) method in ultrasonography (US) resident standardization training during the COVID-19 pandemic.

Methods: Forty-six residents were randomly divided into two groups to participate in a 30-day US training program. The residents in the observation group underwent the PBL combined with lecture-based learning (LBL) mode, while the residents in the control group participated in an integration of the LBL mode alone, with 23 residents in each group. The basic theoretical test, practical examination, and questionnaire were used to evaluate the teaching effect of the PBL+ LBL mode and the LBL mode alone.

Results: The basic theoretical pre-test score of observation group had no significant differences with that of the control group. The post-test theoretical score and practical score were higher in the observation group than that of the control group with significant differences ($P<0.01$). The results of the questionnaire showed that resident's satisfaction in the observation group with PBL combined with LBL method was 96%, which was significantly higher than that of the control group with LBL mode alone (80%) ($P<0.05$).

Conclusion: The combination of PBL with LBL method has obvious advantages over the LBL mode alone in the training of US residents during the COVID-19 pandemic.

Introduction

The World Health Organization (WHO) declared the COVID-19 a pandemic, which has struck most countries in the global [1]. The effects of COVID-19 range all aspects from political, economic, social, healthy system to education and has brought radical changes to lives all over the world. Social distancing and restrictive movement policies have markedly deranged traditional educational practices. The time course of these changes is indeterminate, which have affected conventional ultrasonography (US) education and training. The COVID-19 pandemic has provided us an opportunity to pave the way for introducing innovate teaching methods in US. US residency programs should continue to adapt as the situation unfolds over time. The current pandemic may serve as a catalyzer for the integration of technology and simulating diagnosis in resident education, which are likely to ultimately become part of the future of US education. Various electronic resources and strategies were used to sustain academics during this pandemic. The lecture-based learning (LBL) was a traditional teaching mode based on teachers' courses. It is challenging for radiologists to continuously engage residents online during the pandemic due to issues like attention span, poor dynamic video quality, internet issues, and so on [2]. The problem-based learning (PBL) is a problem-oriented teaching method, guides residents to actively find and analyze problems and to acquire the ability of autonomous learning, which is quite different from the traditional teaching methods [3-5]. We tried to evaluate the effectiveness of the PBL in US resident standardization training during the COVID-19 pandemic.

Methods

The Second Affiliated Hospital Zhejiang University School of Medicine (SAHZJU) is an academic center home to a 3-year residency program training and also a tertiary care facility. A portion of the second- and third-year US residents at our center from 2020 to 2021 were prospectively enrolled in this study. It received institutional review board approval by the committee on clinical investigations at our center (NO. 2021-1088). These US residents were licensed, and had at least 1 year of experience in the US department. Before the start of the study, each resident completed a pre-test to determine the baseline level. Then the residents were randomly divided into two groups: the PBL combined with LBL mode was used in the observation group and the LBL mode alone was used in the control group, with 23 residents in each group. The training course lasted for 30 days, and was divided into theory training and hands-on instructions. The online lectures included liver, gallbladder, and pancreatic theoretical courses (6 classes, 1 hour per class) based on the platform of Ding-talk. The hands-on instructions included clinical application courses of liver, gallbladder, and pancreatic (3 classes, 1 hour each). In this course, residents were introduced to the general principles of ultrasonic, equipment operation, and workflow understanding, comparison of normal anatomy and physiology to pathological features and the differential diagnoses of such findings were also introduced [6].

The residents in the control group with LBL mode alone would be taught in the traditional method (including all the lectures of liver, gallbladder, and pancreatic) online. While the residents in observation group were also provided with PBL mode in addition to the contents of the LBL. The PBL mode was used to provide timely answers and guidance for the problems encountered by participants. Meanwhile, teachers with rich clinical and teaching experience (more than 3 years) were arranged to organize discussions, in which residents were timely notified and organized to participate.

At the end of the study, residents completed a written post-test. Both tests covered physics, the basic examination, liver, gallbladder, and pancreatic sonography, using a single-choice format. The questions were divided into three categories: knowledge-based (50 questions), interpretation (30 questions), and clinical decision-making (20 questions), same as the pre-tests. At the end of the study, residents undergo a proctored practical test in which they are graded on their ability to perform US examination on volunteers in addition to the theory examination. Focused on the investigation of satisfaction with teaching methods, the teaching mode effect was evaluated through a feedback questionnaire survey. The degree of satisfaction with the teaching mode includes satisfaction (80-100 points), general (60-80 points) and dissatisfaction (less than 60 points). Then the satisfaction degree was calculated according to the formula: satisfaction degree = satisfaction rate + general rate [7].

Statistical processing

The SPSS 23.0 software was used, Kolmogorov Smirnov test was used to judge whether the data obeyed the normal distribution. Measurement data were expressed as mean $\pm$ standard deviation, and group t-test was used for the inter-group comparison. Scores on pre-tests and post-tests were compared using a Wilcoxon signed-rank test to assess individual differences (paired analysis). $P < 0.05$ was considered a statistically significant difference.

Results

There were 4 doctors, 17 masters, and 25 bachelors in this study. No significant difference was found between the educational background in the two groups. In the control group, there were 5 male residents and 18 female residents, aged from 24 to 32 years, with an average of (28.1 ± 0.5) years. There were 3 male residents and 20 female residents in the observation group, aged from 24 to 30 years, with an average of (26.8 ± 0.8) years. There was no significant difference in gender and age between the two groups.

Comparison of Academic Performance

All the 46 residents completed the training. The median pre-test score was 75 (range 66–91), compared to a median post-test score of 86 (range 78–97), $P < 0.001$. There was a significant increase in US theory and interpretation questions from the pre-test to post-test.

The residents in control group had a median pre-test score of 76 and a median post-test score of 83. The residents in observation group had a median pre-test score of 75 and a median post-test score of 89. There was no significant difference in pre-test score between control and observation group ($P = 0.12$). The post-test score of observation group was significantly higher than that of the control group ($P = 0.02$). The practical test score of observation group was significantly higher than that of control group (91 Vs. 85, $P < 0.01$) (Table 1).

Survey on the Satisfaction of Residents with Different Teaching mode

Comparing the satisfaction of residents in the two groups, we found that the overall satisfaction of the observation group was significantly higher than that of the control group (Table 2).

Discussion

According to the results of a large meta-analysis of skill decay and retention literature, nonuse of procedural skills may cause skill decay [8]. This has created concerns that some residents may lack adequate training during the COVID-19-Pandemic. Due to the complexity of US, the wide range of knowledge involved, and logic mind being difficult to master, it is hard to achieve the educational goal with the traditional LBL mode online alone. This study aimed to discuss the application of LBL and PBL mode in the training of US in COVID-19-Pandemic.

The online education under the COVID-19-Pandemic has become the inevitability of education reform and development [9-11]. Online lectures break through the time and space limitations for US teaching during the pandemic [10-11]. However, the traditional LBL mode is mainly based on radiologists' lessons of medical imaging so that the students could get a systematic state of the etiology, pathology, clinical features, imaging features, and the course of disease [12]. One benefit of the LBL mode is in which the content is easy to be operated while the participation of the residents is often poor, which restricts the

development of the residents' minds. However, the PBL method guides participants to grasp the key points and stimulates the residents' learning motivation with radiology and clinical problems, which changed the general mode of theory acquisition in medical education. On the basis, the PBL medical learning has become popular in many medical centers [13-15]. The differences between the introduction of PBL into teaching and that of the traditional LBL mode are quite different. The comparison between PBL mode and LBL mode is more like a comparison between active learning and passive learning. Therefore, it is reasonable for the residents in the PBL mode to understand and master US theory better than in the LBL mode alone. The results in this study shown that knowledge had increased in both groups after the study, while the theoretical score of PBL+LBL group was significantly higher than that of the control group. Residents in a PBL mode tended to place more focus on resources utilization such as the online sources in the pandemic era. However, those in a traditional LBL mode alone placed more energy on the resources provided by the radiologists.

US is a comprehensive and practical subject with the characteristics of strong operability and professionalism [16-17], which is very suited to the PBL mode to help the residents better analyze, infer, synthesize, evaluate, think and inquire into how US theory applies to the clinic. The results of this study showed that the group with the PBL mode had higher practical score than that of the control group (LBL mode). Previous studies shown that students who learned through PBL mode were more likely to solve problems spontaneously in the future compared with those participated in a traditional way alone [18-19]. In the traditional LBL mode, residents often lack the comprehensive ability to solve complex affairs. It affected the strengthening process from theory to practice and then to theory, and might not cultivate residents' practical operation ability and clinical skills. The principle of PBL is to provide residents a task or challenge as a source for learning, encourage them to express their ideas and thoughts based on prior tasks or challenges, and to simulate the situations that will occur in clinical practice in their future [20-21]. By critical analysis of the issue, residents participated in the course and mastered what they were told by the radiologists, and developed the required questioning and clinical thoughts skills.

The questionnaire survey in our study showed that residents' satisfaction with US courses has been significantly improved. The traditional LBL method is difficult to mobilize residents' learning enthusiasm. However, learning appeared more 'live' and 'active' in the PBL mode, which might contribute to student satisfaction, motivation and critical thinking [20,22-23]. Residents assumed responsibility for their own learning. The radiologists acted as guides and facilitators instead of providing information alone. Residents became self-directed and collaborative in the study. Another important advantage of PBL was that most of the PBL cases were based on organ systems, which suited the sub-specialization of US.

The sample size was small and it was a single-center study. Therefore, caution should be exercised while analyzing the results. Another limitation of the PBL method was insufficient time allocated to cover the basic theory of US features interpretation, compared with traditional LBL method. It might be difficult to incorporate basic concepts into a PBL course which was based on clinical cases, with the risks of ignoring. That's why we applied the combination of PBL and LBL method in the observation group rather than PBL method alone.

To sum up, the combination of PBL and LBL teaching method can significantly improve residents' theoretical and practical performance, and is popular with residents in the era of COVID-19.

Declarations

Ethics approval and consent to participate: The ethics committee of The Second Affiliated Hospital ZheJiang University School of Medicine approved this study, all methods were carried out in accordance with the institutional guidelines and regulations, and written informed consent was obtained from all participants.

Consent for publication: Not applicable.

Availability of data and materials: the datasets generated and/or analysed during the current study are not publicly available due to limitations of ethical approval involving the participants data and anonymity but are available from the corresponding author on reasonable request.

Competing interests The authors declare that they have no competing interests

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Tables

Table 1 Pre-test and Post-test Scores

Residents	Pre-test Score	Post-test Score	Practical-test score
Observation group	75	89	91
Control group	76	83	85
<i>P</i> value	0.12	0.02	<0.01

Table 2 Satisfaction of Residents

Residents	Satisfaction	General	Dissatisfaction	Satisfaction Degree	<i>P</i> value
Observation group	18	6	1	96%	<0.05
Control group	12	8	5	80%	