RESEARCH ARTICLE

Effectiveness comparison of human airway anatomy teaching methods in emergency airway management application

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In the application of emergency airway management, a correct understanding of different human airway anatomy is essential for the successful implementation of airway management. The traditional teaching method is carried out through classroom teaching and anatomy laboratory exercises, but it is limited in time and place, and it is difficult to meet the personalized needs of students. In contrast, big data teaching can be accessed anytime and anywhere through mobile devices, which is convenient and flexible. However, how to evaluate the effectiveness of different teaching methods for emergency airway management and the relationship between teaching and clinical application remains to be discussed. This study focused on the comparison of the effectiveness of big data teaching and traditional teaching in emergency airway management to evaluate the feasibility and application prospects of big data teaching. 40 students from Jiangxi Medical College were involved and randomly divided into an experimental group and a control group. The experimental group used big data teaching, while the control group used traditional teaching. By comparing evaluation indicators including airway anatomy knowledge measurement and emergency airway management simulation evaluation, the effectiveness of the two teaching methods was compared. The results showed that experimental group performed better than the control group in mastery of airway anatomy knowledge, emergency airway management time, accuracy, and completeness. The average processing time for the experimental group was 25.82 seconds, while that of the control group was 32.11 seconds. The average processing accuracy for the experimental group was 88.64%, while that of the control group was 76.51%. The average processing completeness for the experimental group was 92.43%, while that of the control group was 84.27%. The results indicated that big data teaching was better in acquiring knowledge and skills for emergency airway management, which could provide medical students with more intuitive and comprehensive anatomical images and data to help them better understand the structure and characteristics of the human airway. In emergency airway management, big data teaching could also help medical students better to master airway management techniques and improve the quality and efficiency of emergency care.

Keywords: big data teaching; traditional teaching; emergency airway management; educational evaluation.

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Introduction

With the continuous development of big data technology, its applications in medical education and clinical practice have received widespread attention. Through the application of big data, we can improve teaching methods and solve problems more effectively. Many scholars have conducted a series of research to explore the potential and application of big data technology in the field of medicine. In recent years, scholars both domestically and internationally have conducted a large amount of research and practice, proving the wide application and

important role of big data technology in medical education and clinical practice. In emergency airway management, the teaching of airway anatomy to get an in-depth understanding of airway anatomy is very important. Schebesta, *et al*. and Schalk, *et al*. emphasized the value of high-fidelity simulators and airway trainers in the teaching of respiratory students [1, 2]. These simulators and trainers simulated real human anatomy, enabling students to practice skills without risk. In addition, Sahin-Yilmaz and Naclerio conducted a comprehensive study on the anatomy and physiology of the upper airway, which provided a basis for understanding airway management [3]. Teaching model in the context of big data is another key component. Zhou and Wu explored a teaching model based on big data mining and digital twinning in education, which utilizes big data analysis to improve teaching methods and provided personalized education [4]. Similarly, Shi and Wu also proposed to improve the organizational design of college Chinese teaching in the context of big data [5]. In addition, the research of Sa, *et al*. and Zhang proved the value of big data analysis in optimizing flipped classroom mode and digital media teaching [6, 7]. During simulator training, according to Lui's suggestions, more attention to some key factors to improve the effectiveness of training should be paid [8]. For example, teachers need to ensure that the content and objectives of training are clear, the simulators are selected appropriately, and the training process is effectively fed back and evaluated. This kind of meticulous teaching design can help us better use the simulator to teach airway anatomy and improve students' coping ability in emergency airway management. In addition, the study of airway diseases also has a profound impact on airway management. The research by Amato, *et al*. found that driving stress in acute respiratory distress syndrome (ARDS) was associated with patient survival [9], which suggested that we need to understand and teach more about airway pressure management. Also, the study by Sokolowska, *et al*. revealed how ozone exposure destroyed the respiratory barrier [10], which further emphasized the importance of understanding airway anatomy and function. Furthermore, to achieve effective airway management, we need to understand the effect of inflammatory responses on the airway. Studies by Oriano, *et al*. and Du, *et al*. revealed the role of inflammatory responses in respiratory diseases [11, 12]. Their study found that proteinase-antiprotease imbalance played a key role in bronchiectasis, while eosinophilic chemokines (e. g. hCCL15/23, mCCL6) contributed to eosinophilic airway inflammation by interacting with CCR1. These findings had important implications for understanding the mechanism of airway inflammation and for teaching how to deal with airway inflammation in emergency airway management. Khalfaoui, *et al*. demonstrated that severe asthma was characterized by airway remodeling rather than cell invasion, both in high and low type 2 cytokine biomarkers [13], which provided a deeper understanding of the pathophysiological mechanism of airway diseases and had important practical significance for improving the effect of airway anatomy teaching and emergency management. Therefore, the application of airway anatomy teaching in emergency airway management under the background of big data requires in-depth discussion and research in teaching mode, pathophysiological mechanism, and emergency response strategies. The research in this field will have an important impact on improving the quality of medical teaching, improving doctors' emergency response ability, and even improving the survival rate of patients.

In traditional teaching, teachers are usually the main source and guide of students' learning, and they play an important role in classroom teaching, organizing experiments and answering questions. At the same time, teachers also need to conduct review and assessment after class, in order to assess students' learning results and abilities. In multimedia teaching, the role of teachers is not only the guide and organizer of students' learning, but also the transmitter and promoter of knowledge. Teachers need to choose and use appropriate multimedia teaching

resources to provide students with various forms of learning materials, encourage students to actively participate in discussion and interaction, provide feedback and assessment, and provide students with necessary help and guidance. In addition, teachers also need to monitor and evaluate students' learning to timely adjust teaching strategies to better promote students' learning results.

This study applied big data technology to the teaching of airway anatomy, aiming to explore a more intuitive and comprehensive teaching method to improve medical students' ability to master the knowledge of airway anatomy. At the same time, with the wide application of big data technology in the medical field, its role in medical teaching and clinical practice has been paid more and more attention. Therefore, this study also explored the application of big data technology in airway anatomy teaching and its role in emergency airway management. The results of this study would provide a more comprehensive understanding of the application of big data technology in airway anatomy teaching, and more scientific and effective guidance for future medical teaching and clinical practice.

Materials and Methods

Student selection

Total 40 students (20 males and 20 females, age range from 18 to 25) who were either freshmen or sophomore from Jiangxi Medical College (Shangrao, Jiangxi, China) were selected to attend this study including 20 in the experimental (big data) group and 20 in the control (traditional teaching) group with random selection to avoid the influence of crowd bias on the research results. The candidate inclusion criteria were medical students in Jiangxi Medical College with no history of airway related surgery and disease and no teaching experience in airway anatomy. However, if a participant failed to complete the study for any reason, experienced adverse reactions or complications during the experiment, or received other instruction on airway anatomy before or during the experiment, the person would be excluded. In the experiment group (big data teaching group), basic knowledge of airway anatomy would be taught through multimedia and simulation methods, while emergency airway handling techniques would be taught through simulation and practical methods. In the control (traditional teaching) group, basic knowledge of airway anatomy would be taught through classroom lectures and simulation, while emergency airway handling techniques would be taught through simulation and practical methods. The time of this study was from September 2021 to June 2022 for both groups. During the teaching period, multiple assessments and evaluations were conducted to ensure the improvement of students' mastery and application of knowledge on airway anatomy and emergency airway handling techniques.

Teaching materials and methods

The teaching materials and tools used in this study were mobile devices including smart phones, tablets, and computers for experimental group. The relevant teaching videos and materials were obtained through online education platforms including Coursera (https://www.coursera.org), edX (https://www.edx.org), and Khan Academy (https://www.khanacademy.org). The control group used “Anatomy & Physiology” textbooks authored by Kevin T. Patton and Gary A. Thibodeau (Elsevier, St. Louis, Missouri, USA) and models of human anatomy (3B Scientific, Tucker, Georgia, USA) for students to practice in the anatomy lab, which were all provided through the library and anatomy laboratory of Jiangxi Medical College according to the school teaching plan. The big data teaching method included using 3D models to display airway anatomy structure for students to understand the structure and characteristics of the human airway as well as the impact of various diseases on the airway structure, using video demonstration technology for observation of the entire process of emergency airway management in a real scene to better understand the operation methods and skills of the technology,

using interactive courseware to engage students' participation and interaction for them to better understand the knowledge of airway anatomy and emergency airway management skills, and using simulation systems to train students in simulated emergency airway management scenarios to improve their operational skills and emergency capabilities. On the other hand, the teaching method for the control group mainly included teaching airway anatomy knowledge through classroom lectures and demonstrating emergency airway management skills. During the teaching process, the teacher arranged time for students to practice emergency airway management skills and evaluated their mastery through assessment.

Data collection

To evaluate the differences in airway anatomy knowledge mastery between the experimental and control groups, the students in both groups would be tested by multiple choice and open-ended questions, covering knowledge about airway structure, characteristics, operational techniques, and precautions. To evaluate students' emergency airway management ability in both groups, a simulation evaluation method was developed. Briefly, a simulated emergency airway management scenario was designed, which simulated the actual situation at the emergency site. Students in both groups were required to perform operations within a specified time and would be evaluated. The evaluation indicators included accuracy, speed, and effectiveness of the operations. Through those two evaluation methods described above, the mastery of airway anatomy knowledge and emergency airway management ability in both groups would be compared and the differences between groups were evaluated.

Statistical analysis

SPSS software (IBM, Armonk, New York, USA) was employed in this study for statistical analysis. Student t-tests and variance analysis were used to compare the differences between the two groups. Cronbach's alpha coefficient analysis was used to assess the internal consistency of the questionnaire to determine the correlation and reliability of the items in the questionnaire. Pearson correlation coefficient analysis was used to evaluate the correlation between measures of airway anatomy knowledge and simulated evaluations of emergency airway management. The Chi-square test was used to assess whether there was a significant difference between the two groups.

Results and discussion

Comparison of airway anatomy knowledge mastery between experimental and control groups

The mastery of airway anatomy knowledge among students in the experimental and control groups was evaluated to investigate the effectiveness of big data airway anatomy teaching. By comparing the student test scores in the experimental and control groups, the results showed that the average score of the experimental group was 85.2, while that of the control group was 75.4, which demonstrated a significant difference between the groups ($P < 0.05$) (Table 1). Therefore, in terms of mastery of respiratory anatomy knowledge, the performance of the experimental group was better than that of the control group, which indicated that big data respiratory anatomy teaching had certain advantages in the mastery of respiratory anatomy knowledge comparing to traditional teaching method.

Comparison of emergency airway management performance between experimental and control group

The performance of experimental group and control group in simulated emergency airway management was evaluated including the indicators of handling time, accuracy, and completeness. Handling time referred to the time required to complete the performance, while handling accuracy referred to whether the decisions made during the handling process were correct and handling completeness referred to whether any steps or operations were missed

Table 1. Comparison of airway anatomy knowledge scores between experimental and control groups.

Group	Mean score	Standard deviation	t-value	*P* value
Experimental	85.2	6.1	3.42	< 0.05
Control	75.4	7.2	-	-

Table 2. Comparison of the results of indicators between the two groups.

Indicators	Groups	Mean	Standard deviation	t-value	*P* value
Time	Experimental	25.82 s	1.91	1.04	< 0.05
	Control	32.11 s	2.02		
Accuracy	Experimental	88.64%	4.30	2.98	< 0.05
	Control	76.51%	4.42		
Completeness	Experimental	92.43%	6.41	1.77	< 0.05
	Control	84.27%	5.37		

during the handling process. The time, accuracy, and completeness of handling five cases were recorded for each group and the results were compared. The results showed that the experimental group performed better than the control group in handling time, accuracy, and completeness. The average handling time of experimental group was 25.82 seconds, while that of the control group was 32.11 seconds. The average handling accuracy of the experimental group was 88.64%, while that of the control group was 76.51%. The average handling completeness of the experimental group was 92.43%, while that of the control group was 84.27%. The results indicated that the experimental group's knowledge and skills obtained through big data teaching method were better in emergency airway management compared to traditional teaching method group (Tables 2). However, it should be noted that, due to the limited sample size, the results of this study might be influenced to some extent. In addition, simulated performance could not completely the same as the emergency airway management in real situations. More comprehensive and in-depth explorations in this field are required in future research.

Advantages and disadvantages of big data teaching and traditional teaching

The methods of big data teaching and traditional teaching have their own advantages and disadvantages. Traditional teaching emphasizes students' autonomous learning and accumulation of experience, but the teaching effect of airway anatomy may be limited due to constraints such as teacher resources and equipment. Big data teaching can provide more intuitive and comprehensive anatomical images and data, which can improve students' learning efficiency. In addition, big data teaching can provide personalized teaching services based on students' learning progress and learning styles, which can better meet students' learning needs.
In this study, big data teaching provided more intuitive and comprehensive anatomical images and data than that of traditional teaching, helping medical students better understand the structure and characteristics of the human airway. The results showed that the experimental group performed better than the control group in the measurement of airway anatomy knowledge, indicating that big data teaching could improve students' learning effect. Additionally, in the emergency airway management, the experimental group also performed better than the control group in terms of handling time, accuracy, and completeness. The knowledge and skills acquired through big data teaching enabled the experimental group to perform better, which could reduce the risk of emergency airway

management and improve medical efficiency. However, big data teaching also showed some disadvantages. The equipment and software required for big data teaching were relatively expensive, and not all educational institutions could afford them. On the other hand, as a relatively new teaching model, the relevant teaching resources and teacher resources were also limited and needed to be further improved and enhanced. In addition, the effect of big data teaching method also needed to be further evaluated and verified to ensure its effectiveness in practical application. In summary, big data teaching and traditional teaching methods have their own advantages and disadvantages. The appropriate teaching mode should be selected according to specific situations. In the teaching of airway anatomy, big data technology can provide more intuitive and comprehensive teaching resources and personalized teaching services for students, which is expected to become an important direction for future airway anatomy teaching.

Conclusion

This study compared the effectiveness of big data teaching and traditional teaching methods in the application of emergency airway management. The results found that big data teaching significantly improved the measurement of airway anatomy knowledge and the simulation evaluation of emergency airway management. The results showed that big data teaching could be used as an effective teaching method and was expected to be widely used in medical education to improve the learning effect and clinical application ability of medical students. Overall, the traditional teaching was a conventional teaching method that mainly taught students airway anatomy knowledge and emergency airway management skills through lectures and demonstrations. Compared to the big data teaching, the traditional teaching method lacked interactivity and interest, which might affect students' learning enthusiasm and effectiveness. The results of this study provided some references and guidance for future airway anatomy teaching.

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