

Effect of Problem-based Learning in Training of Cerebrovascular Disease in the Department of Geriatrics

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Abstract: *Objective:* To evaluate the practical teaching effect of problem-based learning (PBL) in the standardized residency training for cerebrovascular diseases in geriatrics. *Methods:* From January 2020 to December 2024, a total of 80 residents and postgraduates in the Department of Geriatrics of the hospital were enrolled and randomly divided into two groups, with 40 cases in each. The control group received conventional lecture-based teaching, while the observation group received problem-based teaching centered on real-life elderly cerebrovascular cases; both groups underwent an 18-month training period, after which their theoretical examination scores and clinical thinking abilities were assessed. *Results:* The scores of theoretical examination and clinical thinking ability in the observation group were significantly higher than those in the control group ($P < 0.05$). *Conclusion:* The problem-based teaching method can effectively improve the theoretical mastery and clinical thinking level of geriatric trainees, and thus deserves wider promotion.

Keywords: Problem-based learning; Elderly cerebrovascular disease; Standardized resident training; Clinical thinking ability; Teaching effect

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1. Introduction

Cerebrovascular disease is an important type of disease that threatens the life and health of the elderly, and coincides with the acceleration of the aging process of the population in China, so its incidence continues to rise, and has become the primary cause of disability and death^[1]. Elderly patients often have a variety of underlying diseases, and the evolution of the disease is complex and changeable, so the level of diagnosis and treatment of clinicians and the ability to deal with emergencies have put forward extremely high requirements^[2]. The traditional teaching mode of “teacher-student passive acceptance” has obvious shortcomings in the training of geriatrics: students are easy to fall into the misunderstanding of disconnection between theory

and practice, and the training of clinical thinking is weak, which makes it difficult to really deal with the complex problems encountered in the process of diagnosis and treatment ^[3]. Problem-based learning (PBL) originated from the concept of PBL proposed by Barrows in 1969. It takes real problems as the starting point, consciously and systematically guides students to explore and construct knowledge independently. In recent years, it has achieved reliable teaching results in neurology, general surgery, gynecological oncology, and other specialties ^[4]. This study focused on the special field of cerebrovascular disease in geriatrics, and systematically evaluated the impact of problem-based learning on the theoretical mastery and clinical thinking ability of the trainees, aiming to provide solid data support and practical reference for the teaching reform of geriatric neurology.

2. Data and methods

2.1. General information

In this study, from January 2020 to December 2024, 80 residents and postgraduates who were receiving standardized resident training in the Department of Geriatrics of our hospital were enrolled, and they were divided into two groups by random number table method, with 40 trainees in each group. There were 15 males and 25 females in the control group, ranging from 19 to 23 years old, with an average of (22.05 ± 1.17) years old; there were 17 males and 23 females in the observation group, ranging from 19 to 23 years old, with an average of (21.72 ± 1.35) years old, and the general data of the two groups were balanced and comparable ($P > 0.05$).

Inclusion criteria: (1) Those who had obtained the qualification of licensed physician or were studying for a master's degree in clinical medicine; (2) Those who had been trained in the Department of Geriatrics for no less than 18 months; (3) Those who knew and signed the consent form for teaching and research.

Exclusion criteria: (1) The training period was interrupted for more than 3 months for some reason; (2) Those who had participated in PBL training in the past; (3) Patients with severe cognitive impairment or mental illness.

2.2. Method

Control group: The traditional teaching mode was used. According to the training syllabus, the teachers gave systematic lectures covering the etiology, pathology, diagnostic criteria, and treatment principles of cerebrovascular diseases in the elderly, supplemented by teaching rounds and case discussions. The trainees mainly listened passively and completed the prescribed medical record writing tasks after class.

Observation group: implement the problem teaching method; the specific operation is as follows:

- (1) Creating problem situations: The teacher selected real cerebrovascular cases (acute ischemic stroke with atrial fibrillation, cerebral hemorrhage with diabetic ketosis, etc.). In the Department of Geriatrics, the teacher distributed the case data to the trainees in advance and asked them to consult textbooks, literature, and the latest guidelines for the diagnosis and treatment of cerebrovascular diseases before class, and systematically analyzed the high-risk factors, morbidity mechanism, and diagnosis direction of patients.
- (2) Guided question orientation: In class, the teacher puts forward the core question chain around the case, such as "Which blood vessel may be responsible for the patient?" "How to distinguish cardiogenic embolism from atherosclerotic thrombosis?" The trainees discuss in groups, and each group has a group

leader responsible for reporting. The division of roles covers the medical history collector, the operator of nervous system examination, the reader of image judgment, etc.

- (3) Independent exploration and program design: The trainees first consulted the Chinese Journal of Stroke, Neurology Guidelines, and other materials, and then combined with the basic knowledge of neuroanatomy and neuropathophysiology to put forward a preliminary diagnosis and treatment program, while the teacher only gave appropriate guidance on the train of thought, not directly giving the answer.
- (4) Feedback summary and expansion: After the report of each group, the teacher made appropriate comments on the advantages and disadvantages of the student program, summarized the knowledge points, arranged the expansion questions, and formed a closed-loop learning mode of “raising questions-analyzing problems-solving problems-questioning again.”

The training cycle is 18 months, and two courses of problem teaching methods are arranged every week, each of which lasts 90 minutes.

2.3. Observation index

- (1) Theoretical examination results: The results were assessed by a closed-book examination with unified propositions. The content of the examination covered four modules, including the basic theory, diagnostic criteria, treatment guidelines, and complication treatment of cerebrovascular disease in the elderly. The score of each module was set at 25 points, and the total score of the four items was 100 points.
- (2) Clinical thinking ability score: The standardized clinical thinking ability assessment scale was used to quantify the score. The scale was scored from four dimensions: the integrity of medical history collection, the rationality of diagnostic logic, the breadth of differential diagnosis, and the degree of individualization of the treatment plan. Each score was 25 points, and the total score was 100 points.

2.4. Statistical analysis

The data involved in this study were processed by SPSS 23.0 software. The data of the χ^2 and t tests were count and measurement data, and the count and measurement data were also processed by (%) and (Mean \pm SD) means. When the difference meets the statistical condition, $P < 0.05$.

3. Results

3.1. Comparison of theoretical examination results

Table 1 shows that the observation group was better in the four modules of basic theory, diagnostic criteria, treatment guidelines, and complication treatment, and the total score ($P < 0.05$).

Table 1. Comparison of theoretical examination results between the two groups (Mean \pm SD, minutes)

| Group | Number of cases | Basic theory | Diagnostic criteria | Treatment guidelines | Complication management | Total score |
|-------------------|-----------------|------------------|---------------------|----------------------|-------------------------|------------------|
| Observation group | 40 | 22.15 \pm 2.31 | 21.87 \pm 2.42 | 21.63 \pm 2.58 | 20.70 \pm 2.79 | 86.35 \pm 5.72 |
| Control group | 40 | 18.42 \pm 2.86 | 18.05 \pm 3.01 | 18.32 \pm 2.97 | 18.39 \pm 3.13 | 73.18 \pm 6.42 |
| t -value | - | 6.415 | 5.936 | 5.425 | 3.612 | 5.826 |
| P value | - | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |

3.2. Comparison of clinical thinking ability scores

Table 2 shows that the observation group had higher scores in the four dimensions of completeness of medical history collection, rationality of diagnosis logic, breadth of differential diagnosis, and individualization of treatment plan, as well as the total score of clinical thinking ability ($P < 0.05$).

Table 2. Comparison of clinical thinking ability scores between the two groups (Mean \pm SD, minutes)

| Group | Number of cases | Completeness of medical history collection | Logical rationality of diagnosis | Breadth of differential diagnosis | Individualized degree of treatment plan | Total score |
|-------------------|-----------------|--|----------------------------------|-----------------------------------|---|------------------|
| Observation group | 40 | 21.79 \pm 2.15 | 21.51 \pm 2.36 | 21.05 \pm 2.48 | 20.25 \pm 2.63 | 84.62 \pm 4.91 |
| Control group | 40 | 17.62 \pm 2.79 | 17.83 \pm 2.94 | 17.42 \pm 3.01 | 18.69 \pm 3.15 | 71.55 \pm 5.88 |
| <i>t</i> -value | - | 7.525 | 6.181 | 5.817 | 2.525 | 6.562 |
| <i>P</i> value | - | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |

4. Discussion

The teaching of cerebrovascular disease in the elderly has always been a focus and difficulty in the training of neurology; the fundamental reason is that elderly patients often have hypertension, diabetes, coronary heart disease, cognitive dysfunction, and other underlying diseases, so the occurrence and development of cerebrovascular disease are highly heterogeneous and dynamic^[5-6]. Under the traditional teaching mode, students tend to remember scattered knowledge points, but often have no way to start when they encounter real clinical problems. This learning dilemma is essentially directly related to the traditional teaching mode in which teachers occupy the absolute dominant position and students passively accept knowledge^[7]. The core idea of the problem teaching method can be naturally and properly traced back to the PBL concept put forward by Barrows in 1969, that is, taking “raising problems-analyzing problems-solving problems” as the main line framework, the teaching focus is clearly and reasonably transformed from teachers’ “teaching” to students’ “learning.” Students are guided to actively construct knowledge in real or simulated problem situations^[8]. In the teaching of cerebrovascular disease in the department of geriatrics, the problem teaching method can design a clinical problem chain highly related to elderly patients, which forces students to use the knowledge of neuroanatomy, neuropathophysiology, cerebrovascular imaging, diagnostics and other disciplines for clinical reasoning, and this interdisciplinary thinking training just meets the actual requirements of the comprehensive ability of the diagnosis and treatment of cerebrovascular disease in the elderly^[9]. In recent years, PBL teaching has shown clear advantages over traditional teaching in gynecological oncology, general surgery, neurology, and other training fields^[10].

In this study, the problem-based teaching method in the observation group strictly followed the operating procedure of “three rings and six steps”: the first step was to create a problem situation, in which the teacher selected real cerebrovascular cases in the Department of Geriatrics, distributed the medical history, signs and imaging data of the cases in advance, and required the students to complete the literature search and preliminary thinking before class; The second part is independent exploration, in which the students discuss the core issues such as the determination of responsible blood vessels, etiological analysis and differential diagnosis in groups, and the teachers only give directional tips at key nodes; the third part is feedback expansion, in which the teachers summarize and comment after each group reports, and set extended

questions to consolidate the learning effect. The control group followed the traditional mode of teacher-based teaching, and the training time and teaching staff of the two groups were consistent, which controlled the interference of confounding factors to the greatest extent.

The results showed that the total score of theoretical assessment in the observation group was higher than that in the control group ($P < 0.05$), and there were statistical differences in basic theory, diagnostic criteria, treatment guidelines, complications, and other sub-items. Therefore, it was concluded that the problem teaching method was conducive to the integration of fragmented knowledge into a systematic and orderly cognitive structure by means of repeated problem-driven and independent inquiry. Therefore, the depth of memory and the quality of understanding are better than simple listening learning. At the same time, the total score of clinical thinking ability in the observation group was also better than that in the control group ($P < 0.05$), and the gap between the breadth of differential diagnosis and the integrity of history collection was the most prominent, which was perfectly consistent with the teaching concept of the problem teaching method advocating multi-angle analysis and actively putting forward different hypotheses. The advantage of the observation group in the degree of individualization of the treatment plan also reached statistical significance ($P < 0.05$), indicating that the trainees have initially mastered the method of adjusting the diagnosis and treatment plan according to the specific conditions of elderly patients after receiving the training of problem teaching method, which is the most difficult core literacy to be directly cultivated by the traditional teaching mode.

5. Conclusion

To sum up, the problem-based teaching method shows significant application value in geriatric cerebrovascular disease training teaching, which can not only effectively improve the theoretical assessment results of students, but also comprehensively strengthen their clinical thinking ability, especially in the key dimensions of medical history collection, differential diagnosis, individualized treatment, and so on. This teaching method takes the problem as a link, combines theory with practice closely, and fully mobilizes the students' learning initiative and spirit of inquiry, which provides strong empirical support for the reform of the teaching mode of geriatric neurology, and suggests that it should be promoted in a wider range of regular training teaching.

Disclosure statement

The authors declare no conflict of interest.

References

- [1] Chen F, Zhan SF, 2025, Effect of Problem-based Learning in Neurosurgery Cerebrovascular Disease Practice Teaching. *China Health Industry*, 22(1): 207–209.
- [2] Huang CL, 2025, Application Effect of Problem-based Learning in Clinical Teaching of Cerebrovascular Disease in Neurosurgery. *China Health Industry*, 22(11): 179–181.
- [3] Meng T, Yang L, Zhang HL, et al., 2022, Application Effect of Problem-oriented Combined Evidence-based Medicine Teaching Method in Standardized Training of Residents in Advanced Stroke Center. *Chinese Journal of*

Stroke, 17(6): 664–666.

- [4] Meng SJ, Zhuo ZZ, Xu R, et al., 2021, Meta-analysis of the Effect of Problem-based Learning and Teaching Learning on Clinical Teaching of Cerebrovascular Disease in China. *Chinese Journal of Stroke*, 16(8): 864–872.
- [5] He P, Chen J, Zhang SY, 2024, Analysis of the Effect of Problem-based Learning on Clinical Teaching of Neurology. *China Health Industry*, 21(15): 183–185.
- [6] Lu Y, Zhu JY, Pan Y, et al., 2025, Application of PBL Combined with CBL in the Teaching of Tumor Immunotherapy in the Standardized Training of Residents. *Journal of Cellular and Molecular Immunology*, 41(6): 571–574.
- [7] Zheng QY, Wang SP, Zhang YZ, et al., 2025, Differentiation Status of Medical Teaching Quality Evaluation System and Exploration of Core Index Set Construction Path. *China Medical Guide*, 27(7): 721–727.
- [8] Su Y, Luo SS, Liu FT, et al., 2025, Application of Interactive Teaching Mode Based on Evidence-based Medicine in Neurology Demonstration. *Medical Education Research and Practice*, 33(6): 923–928.
- [9] Yan DD, Tian XL, Huang WX, et al., 2023, Meta-analysis of the Application Effect of EBM combined with PBL in Standardized Resident Training in China. *Medical Education Management*, 9(5): 641–648.
- [10] Song J, Yan LZ, Li N, et al., 2024, Application Effect of Problem-oriented Teaching Method Combined with Case Discussion Teaching Method in Pediatrics Teaching. *Women’s and Children’s Health Guide*, 3(3): 182–185.

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