Innovation and Practice of a Multidisciplinary Team Teaching Model for Subarachnoid Hemorrhage Led by the Department of Neurology

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Abstract: *Objective:* To establish a neurology-led multidisciplinary team (MDT) teaching model for subarachnoid hemorrhage (SAH), addressing prominent specialty barriers and fragmented clinical thinking in traditional teaching, and to enhance the diagnostic and therapeutic capabilities of resident and visiting physicians in managing SAH. *Methods:* A total of 56 physicians who participated in SAH diagnostic and therapeutic training in the neurology department of our hospital from January 2024 to June 2025 were selected and divided into an observation group (28 physicians, using the MDT innovative teaching model) and a control group (28 physicians, using the traditional specialty teaching model). The observation group, centered on neurology, integrated resources from emergency surgery, neuroradiology, neurointensive care unit, rehabilitation medicine, and other disciplines to construct a four-dimensional teaching system of "theoretical foundation–simulated practice–clinical practice–review and optimization," incorporating AI-assisted diagnostic tools and standardized diagnostic and therapeutic approaches. The control group adopted the traditional model of classroom lectures combined with bedside teaching. The application effects of the two teaching models were compared through theoretical assessments, clinical skill operation scores, case analysis ability evaluations, and teaching satisfaction surveys. *Results:* The observation group achieved significantly higher average scores than the control group in theoretical assessment (89.63 ± 4.25 vs. 82.15 ± 5.38), clinical skill operation (91.37 ± 3.81 vs. 83.46 ± 5.12), and case analysis ability (90.24 ± 4.16 vs. 81.79 ± 5.43), with statistically significant differences ($P < 0.05$). The overall satisfaction with the teaching model was also higher in the observation group compared to the control group, with statistically significant differences ($P < 0.05$). *Conclusion:* The neurology-led MDT innovative teaching model for SAH can effectively break down specialty barriers, enhance physicians' interdisciplinary collaboration abilities and SAH diagnostic and therapeutic levels, demonstrating significant teaching effects and warranting promotion and application in clinical teaching.

Keywords: Neurology; Subarachnoid hemorrhage; Multidisciplinary collaboration; Teaching model; Clinical teaching

1. Introduction

Subarachnoid hemorrhage (SAH) is one of the leading neurological disorders causing death and disability worldwide, characterized by its acute onset, rapid progression, and life-threatening nature. The 30-day case fatality rate ranges from 35.00% to 52.00%, and approximately 70.00% of survivors suffer from varying degrees of neurological dysfunction. The diagnosis and treatment of SAH involve multidisciplinary expertise, requiring collaborative efforts from neurology, emergency neurosurgery, neuroradiology, and other specialties to achieve precise diagnosis, timely intervention, and comprehensive management. However, traditional clinical teaching models, centered on a single specialty, suffer from fragmented teaching content, a lack of interdisciplinary collaboration training, and a disconnect between theory and clinical practice. As a result, physicians trained under these models struggle to rapidly adapt to the multidisciplinary diagnostic and therapeutic demands of SAH, often leading to delayed decision-making and non-standardized treatment in clinical practice. With the widespread adoption of precision medicine and integrated healthcare concepts, the multidisciplinary team (MDT) model has become the core paradigm for SAH diagnosis and treatment, placing higher demands on clinicians' interdisciplinary thinking and collaborative abilities [1]. Based on this, this study constructs an innovative MDT teaching model for SAH, centered on neurology, by integrating multidisciplinary teaching resources, optimizing teaching processes, and incorporating intelligent diagnostic tools to address the shortcomings of traditional teaching. The aim is to cultivate clinicians with systematic diagnostic and therapeutic thinking and efficient collaborative abilities, providing data support and professional talent reserves for the standardization of SAH diagnosis and treatment.

2. Materials and methods

2.1. General information

A total of 56 physicians who participated in the SAH diagnosis and treatment training at our hospital from January 2024 to June 2025 were selected, including 35 males and 21 females. Their ages ranged from 23 to 35 years, with an average age of 28.63 ± 3.15 years. Among them, there were 37 standardized training physicians and 19 visiting physicians. They were randomly divided into an observation group and a control group using a random number table method, with 28 cases in each group. There were no statistically significant differences in general information, such as gender, age, educational background, and clinical experience, between the two groups ($P > 0.05$), indicating comparability.

2.2. Teaching implementation

Both groups underwent a three-month teaching training. The control group adopted the traditional teaching mode, namely "classroom theoretical teaching + bedside teaching." The theoretical teaching mainly focused on specialized knowledge in the Department of Neurology, and the bedside teaching was solely undertaken by neurologists. The observation group adopted the MDT innovative teaching mode constructed in this study, which strictly followed the process of "theoretical foundation–simulated practical operation–clinical practice–review and optimization" for teaching implementation. The MDT teaching team collaboratively conducted the teaching, as detailed below.

    (1) A chief physician from the Department of Neurology was appointed as the overall teaching leader. Key physicians from various disciplines were selected to form the MDT teaching team, including 3 from the Department of Neurology, 2 from the Department of Neurosurgery, 3 from the Department of Emergency Surgery (including 2 who transferred from neurosurgery), 2 from the Department of

Neuroradiology, 2 from the Department of Neurocritical Care Medicine, and 1 from the Department of Rehabilitation Medicine. All team members had more than 5 years of clinical work experience and more than 3 years of teaching experience. The teaching responsibilities of each discipline were clearly defined: the Department of Neurology was responsible for core theoretical teaching, neurological function assessment teaching, and overall process coordination; physicians specializing in neurosurgery in the Department of Emergency Surgery focused on teaching surgical indication judgment and key points of minimally invasive surgical operations, as well as teaching the processes of emergency admission, initial management, and rapid transfer; the Department of Neuroradiology concentrated on teaching the interpretation of multimodal imaging (CT, CTA); the intensive care unit of the Department of Neurocritical Care Medicine was responsible for teaching intracranial pressure monitoring and complication management; the Department of Rehabilitation Medicine was in charge of teaching the formulation of early rehabilitation intervention plans. A regular lesson preparation and communication mechanism was established, with one MDT teaching seminar held each month to unify teaching objectives and optimize teaching content, ensuring teaching collaboration.

(2) Based on the entire process of SAH diagnosis and treatment and teaching requirements, a multidimensional and interdisciplinary teaching content system was constructed, covering four major modules: theory, practical operation, clinical practice, and knowledge review. These modules were organically connected and progressively advanced. (a) The "online preview + offline in-depth teaching + interdisciplinary discussion" mode was conducted. Online, preview content such as SAH diagnosis and treatment guidelines, multidisciplinary expert consensus, and typical case data was pushed through the learning platform, and students were required to complete the learning content before class. Offline, teachers from each discipline gave in-depth lectures on core knowledge points, mainly including the pathophysiological mechanisms of SAH, multimodal imaging diagnosis, medical drug treatment, surgical treatment, intensive care, and early rehabilitation. After each class, interdisciplinary discussions were organized. Students were guided to analyze and discuss hot topics, including hybrid surgical management of ruptured aneurysms and risk assessment and intervention strategies for aneurysm re-rupture, from a multidisciplinary perspective to cultivate interdisciplinary thinking. This module accounted for 30.00% of the total teaching time. (b) Relying on the hospital's clinical skills training center, a simulated SAH diagnosis and treatment platform was established, equipped with simulators, multimodal imaging simulation systems, intracranial pressure monitoring simulation devices, and lumbosacral cistern drainage simulation instruments. Immersive practical training was carried out. Five practical operation scenarios were set up: "emergency admission and assessment," "multimodal imaging interpretation," "intracranial pressure monitoring operation," "lumbosacral cistern drainage simulation," and "multidisciplinary consultation drill." Each group consisted of 20–30 students and was divided into subgroups for training, with 2 teaching instructors assigned to each group for guidance. In the multidisciplinary consultation drill, role-playing was carried out. Students played the roles of physicians from different disciplines respectively, simulated the real consultation process, put forward diagnosis and treatment suggestions from their own disciplinary perspectives, and jointly formulated a comprehensive treatment plan. This module accounted for 35.00% of the total teaching time, strengthening students' practical operation and collaboration abilities. (c) SAH patients in the emergency department and the intensive care unit of the Department of Neurology at our hospital were selected as practical cases, and the "one-on-one bedside teaching + group shift management" mode was

adopted. Students, in groups, participated in the entire process management of patients from emergency admission, examination and diagnosis, multidisciplinary consultation, treatment implementation to condition monitoring. Under the guidance of teaching instructors, they independently completed tasks such as neurological function assessment, medical record writing, and preliminary formulation of diagnosis and treatment plans. Teaching instructors tracked the whole process and promptly corrected students' problems in operations and decision-making to ensure the accuracy of diagnosis and treatment. Meanwhile, AI-assisted diagnosis and treatment tools were introduced to guide students to use the AI system for risk assessment and optimization of diagnosis and treatment plans, improving precise diagnosis and treatment capabilities. This module accounted for 25.00% of the total teaching time. (d) A "case review + effect feedback" mechanism was established. After the management of each practical case was completed, a review meeting was organized by the MDT teaching team and students. Students reported the diagnosis and treatment process, existing problems, and learning insights. Teaching instructors from each discipline commented from a professional perspective, analyzed the advantages and disadvantages of the diagnosis and treatment plans, and guided students to summarize their experience and optimize thinking. At the same time, feedback from students on teaching content and teaching methods was collected through questionnaires and group discussions, and teaching plans were adjusted accordingly to form a closed-loop optimization. This module accounted for 10.00% of the total teaching time.

(3) The teaching methods of "hierarchical teaching + group collaboration + intelligent assistance" were adopted to balance teaching efficiency and quality: (a) Hierarchical teaching: According to students' educational backgrounds and clinical experience, each group was divided into a basic level (standardized training physicians with no clinical experience) and an advanced level (visiting physicians with 1–2 years of clinical experience). The basic level focused on basic theory and operation training, while the advanced level focused on complex case analysis and multidisciplinary collaboration ability cultivation. (b) Group collaboration: Each group was divided into 4–6 subgroups, with 4–5 students in each subgroup. A subgroup leader was appointed to be responsible for learning organization and task allocation within the subgroup. In the simulated practical operation and clinical practice links, work was carried out in subgroups to cultivate team collaboration ability. (c) Intelligent assistance: Online learning platforms were used to push teaching resources and organize online tests. AI-assisted diagnosis and treatment simulation systems specifically designed for SAH were employed to deliver personalized training, overcoming temporal and spatial limitations and enhancing teaching efficiency.

(4) Breaking away from the traditional single theoretical assessment mode, a diversified evaluation system of "process + result, quantitative + qualitative" was established for comprehensive assessment from four dimensions, with the weights of each dimension as follows: theoretical knowledge (25.00%), practical operation ability (30.00%), clinical thinking and collaboration ability (35.00%), and teaching satisfaction (10.00%). (a) Theoretical knowledge: SAH diagnosis and treatment guidelines and multidisciplinary core knowledge points were assessed through closed-book examinations. (b) Practical operation ability: Students' skills, such as neurological function assessment, intracranial pressure monitoring operation, and multimodal imaging interpretation, were assessed in simulated platforms and clinical scenarios. (c) Clinical thinking and collaboration ability: Students' case analysis, plan formulation, and interdisciplinary communication and collaboration abilities were assessed through typical case analysis and multidisciplinary consultation drills. (d) Teaching satisfaction: Students'

evaluations of teaching content, teaching methods, and teaching instructors were collected through questionnaires.

2.3. Observation indicators

(1) Core competence assessment results: After the teaching, core competence assessments were conducted on students in both groups, including three dimensions: theoretical knowledge, practical operation ability, and case analysis ability, using a 100-point scoring system. (2) Teaching satisfaction: A self-designed teaching satisfaction questionnaire was used to evaluate five dimensions: "integration of interdisciplinary knowledge," "cultivation of clinical thinking," "improvement of practical operation ability," "level of teaching instructors," and "overall teaching effect." The evaluation was divided into four levels: "very satisfied," "satisfied," "fair," and "dissatisfied." Satisfaction = (number of very satisfied cases + number of satisfied cases) / total number of cases × 100%.

2.4. Statistical methods

SPSS 26.0 statistical software was used for data analysis. Measurement data were expressed as mean ± standard deviation (SD), and paired t-tests were used for comparisons before and after training. Count data were expressed as [n (%)], and χ^2 tests were used for comparisons. A P-value < 0.05 was considered statistically significant.

3. Results

3.1. Comparison of core competence assessment scores between the two groups of students

The assessment scores of the observation group were significantly higher than those of the control group in all aspects ($P < 0.05$). Specific data are shown in **Table 1**.

Table 1. Comparison of core competence assessment scores between the two groups of students (mean ± SD, points)

Group	Number of cases	Theoretical knowledge	Practical skills	Case analysis ability
Observation group	43	89.63 ± 4.25	91.37 ± 3.81	90.24 ± 4.16
Control group	43	82.15 ± 5.38	83.46 ± 5.12	81.79 ± 5.43
t	-	7.821	8.532	8.01
P	-	<0.05	<0.05	<0.05

3.2. Comparison of teaching satisfaction between the two groups of students

The results showed that the overall teaching satisfaction in the observation group was 96.43%, significantly higher than the 71.43% in the control group. The satisfaction in each dimension was also better than that in the control group ($P < 0.05$). Specific data are presented in **Table 2**.

Table 2. Comparison of teaching satisfaction between the two groups of students [n (%)]

Evaluation dimension	Observation group (n = 43)	Control group (n = 43)	χ^2	P
Interdisciplinary knowledge integration	26 (92.86)	20 (71.43)	4.383	<0.05
Clinical thinking cultivation	27 (96.43)	20 (71.43)	4.766	<0.05
Practical skills improvement	25 (89.29)	18 (64.29)	4.909	<0.05
Teaching instructor competence	27 (96.43)	20 (71.43)	4.766	<0.05
Overall teaching effectiveness	27 (96.43)	20 (71.43)	4.766	<0.05

4. Discussion

Currently, the traditional teaching model of "specialty-led + classroom lectures + bedside teaching" is predominantly adopted in clinical teaching for SAH. While it can impart basic theoretical knowledge, it has significant deficiencies in cultivating physicians' comprehensive diagnosis and treatment capabilities. The main pain points are as follows:

(1) Traditional teaching centers around the single discipline of neurology, with teaching content limited to specialized knowledge such as neurological function assessment and medical drug treatment. It covers relatively little interdisciplinary content, including the judgment of surgical indications for SAH, the interpretation of multimodal imaging in neuroradiology, and key points of neurocritical care. Physicians lack a systematic understanding of the entire process of SAH diagnosis and treatment, which easily leads to the formation of a "specialty-specific mindset." As a result, it is difficult for them to collaborate efficiently with other disciplines in clinical practice.

(2) Traditional teaching mainly relies on classroom lectures, accounting for over 60.00% of the teaching time, with abstract content and a lack of practicality [2]. Bedside teaching often adopts a "teacher demonstration + student observation" model, resulting in low active participation. Moreover, due to factors such as the randomness of clinical cases and the critical condition of patients, it is difficult for students to systematically access key aspects of SAH diagnosis and treatment. This leads to a disconnect between theoretical knowledge and clinical practice, preventing students from quickly applying what they have learned to actual work and effectively enhancing their core competencies.

(3) Traditional teaching emphasizes one-way imparting of knowledge points and lacks systematic training of physicians' clinical thinking [3]. During the teaching process, teachers often directly provide diagnosis and treatment plans without guiding students to conduct multidimensional analysis, risk assessment, and plan optimization. This results in students lacking independent thinking and decision-making abilities, and they are prone to confusion and decision-making errors when facing complex SAH cases.

(4) Traditional teaching evaluation mainly focuses on theoretical assessment, accounting for over 70.00% of the evaluation, and lacks evaluation of core competencies such as clinical skills, collaboration abilities, and thinking abilities [4]. The evaluation method is single, and the feedback is delayed, which makes it impossible to comprehensively reflect the teaching effectiveness. It is also difficult to optimize teaching plans in a targeted manner, affecting the continuous improvement of teaching quality.

The MDT teaching model for SAH led by the Department of Neurology constructed in this study demonstrates significant advantages through the integration of multidisciplinary resources, optimization of the teaching process, and innovation of the evaluation system.

Firstly, it breaks down disciplinary barriers and achieves deep integration of interdisciplinary knowledge.

Centered on neurology, it integrates teaching resources from six disciplines, covering the entire process of SAH diagnosis and treatment. This effectively compensates for the lack of interdisciplinary content in traditional teaching and helps students establish a systematic understanding of diagnosis and treatment of SAH [5].

Secondly, it strengthens practical and real-world training to enhance clinical application abilities. Relying on simulated diagnosis and treatment platforms and clinical real-world cases, it adopts immersive training and group collaboration models, enabling students to shift from "passive observation" to "active participation," significantly improving their practical operation and clinical decision-making abilities.

Thirdly, it is suitable for teaching groups of 20–30 students, balancing efficiency and quality [6]. Through hierarchical teaching, group collaboration, and intelligent-assisted teaching, it ensures teaching coverage while providing personalized guidance, solving the problem of difficult quality control in large-scale teaching [7].

Fourthly, the diversified evaluation system comprehensively reflects teaching effectiveness and provides a basis for teaching optimization, forming a closed-loop mechanism of "teaching-assessment-feedback-optimization."

From the perspective of practical effects, the observation group significantly outperformed the control group in theoretical assessment, practical operation ability, and case analysis ability, and teaching satisfaction was greatly improved, confirming the effectiveness of this model. This is consistent with the conclusions of relevant studies at home and abroad. For example, the podcast-based flipped classroom MDT teaching model significantly enhanced neurology residents' confidence in diagnosing and treating emergencies [8,9]. Tongji Hospital improved physicians' precise diagnosis and treatment abilities through AI large model-assisted MDT teaching [10].

5. Conclusion

In conclusion, the innovative MDT teaching model for SAH led by the Department of Neurology effectively addresses the pain points of traditional teaching, improves physicians' comprehensive diagnosis and treatment abilities and interdisciplinary collaboration abilities, and provides a new path for the cultivation of SAH diagnosis and treatment talents. It is worthy of promotion and application in clinical teaching.

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Disclosure statement

The authors declare no conflict of interest.

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