Systematic teaching method to enhance the effectiveness of training for paragonimiasis

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The clinical symptoms of human paragonimiasis are complex and variable, and patients can easily be misdiagnosed. *Pagumogonimus skrjabini* is the species causing this disease found only in China. A 2002 epidemiological survey showed that the rate of paragonimiasis was 21.96% in the migration areas of the Three-Gorge Reservoir, Chongqing, China. Therefore, there is a need to train medical workers to treat individuals in these areas. The Third Military Medical University (TMMU) in Chongqing built a comprehensive and systematic teaching method, which included teaching students about the basic biology of the organism, guiding students to use appropriate diagnostic tests and participate in scientific research to develop diagnostic kits, and visiting endemic areas to provide on-site teaching. The use of on-site teaching is an innovative approach for training undergraduate medical students in human parasitology. Three improvements were implemented during the on-site teaching component of the program: (1) systematizing the learning process; (2) integrating formal knowledge with clinical experience; and (3) enhancing students' knowledge of medical ethics. Based on a survey, 95% of students believed that this systematic teaching system gave them a more comprehensive grasp of knowledge on *P. skrjabini*, and graduate students were able to provide early diagnosis of *P. skrjabini* cases in this remote region. Students also participated in the research and development of a *P. skrjabini* diagnostic kit, for which a patent has been applied, and during the on-site teaching process, data were collected for the government and health sector to assist in public-health planning and decision-making for this disease.

Keywords: *Pagumogonimus skrjabini*, systematic teaching method

Introduction

Paragonimiasis is an important food-borne zoonosis caused by lung flukes of the genus *Pagumogonimus*.¹ In China, the prevalence of this disease varies across the 26 provinces, municipalities, and autonomous regions of the country.^{2,3} *Pagumogonimus skrjabini* is the species found only in China, and is the main species causing extrapulmonary paragonimiasis in humans. Human paragonimiasis presents with a complex set of clinical symptoms; thus, people with the condition have a high risk of misdiagnosis and consequent delayed treatment.⁴

A 2002 epidemiological survey showed that the rate of paragonimiasis in the migration areas of the Three-Gorge Reservoir, Chongqing, was 21.96%.⁵ Therefore, there is a need for medical workers who are trained to treat individuals living in these areas. In recent years, there has been an increase in the incidence of food-borne parasitic diseases; thus, in the major medical colleges, teaching about such

diseases is becoming increasingly important. However, we found that there was a lack of a comprehensive and systematic learning process about this subject.⁶

The Third Military Medical University (TMMU), located in Chongqing, China, has the important task of training doctors for local community and military hospitals, and for practices serving local people and military units. There is a long history of *P. skrjabini* infection in the southwestern region of China, thus the TMMU has accumulated a wealth of data on basic research, diagnosis, and treatment of paragonimiasis, and has built a comprehensive and systematic teaching method for this condition, which could provide a basis for teaching for other parasitic and endemic diseases.

Materials and Methods

Students at TMMU study the life cycle and diagnosis of *P. skrjabini* in their fourth semester; they participate in scientific research work from their fourth to sixth semesters; and study clinical medical sciences and the treatment of *P. skrjabini* from their sixth to eighth semesters (Fig. 1). During their ninth

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Figure 1 Flow chart indicating how this method enhanced the effectiveness of the teaching.

semester, students work as interns at the hospital in the Three-Gorge Reservoir area for 1 week, where they receive on-site teaching. This method of on-site teaching is an innovative approach for training undergraduate medical students in human parasitology.

Three improvements were implemented during the on-site teaching component of the program: (1) systematizing the learning process; (2) integrating formal knowledge with clinical experience; and (3) enhancing the students' knowledge of medical ethics.

Results and Discussion

Systematization of the learning process

Because of the complex clinical presentation of *P. skrjabini* infestation, and the consequent relatively high risk of clinical misdiagnosis, we aimed to train our medical students to acquire comprehensive and relevant knowledge of the disease, taking advantage of the long-standing experience in scientific research, diagnosis, and treatment of *P. skrjabini* in the TMMU. Therefore, we designed a systematic teaching method

for *P. skrjabini* (Table 1), aimed at giving students basic knowledge of diagnosis, treatment, and scientific research, teaching them to explore the pathogenic mechanisms and to use diagnostic techniques, and finally providing on-site teaching in an endemic area. In order to enrich the teaching process, we also enhanced the teaching process by using new methods during lectures on theory, such as discussing problems and including participatory teaching by the students themselves. The classroom atmosphere was enlivened by these methods, and it also improved the effectiveness of the teaching and the students' ability to learn independently. In the experimental classes, students learned how to use routine diagnostic methods for pathogens such as ELISA, and how to isolate metacercariae from crabs, prepare crude antigen extract, and separate the *P. skrjabini* surface-specific antigen. This process enabled students to master the diagnostic methods used for the pathogen, and to develop the ability to carry out investigations by means of scientific experiments. Through the clinical teaching in affiliated hospitals and the on-site teaching

in endemic areas, students experience a variety of clinical presentations in patients with *P. skrjabini*, enabling them to understand the complex performance of *P. skrjabini*, and thus lay the foundation for the timely and effective diagnosis of the disease in future work. This comprehensive *P. skrjabini* teaching method thus provides students with the basic knowledge of the disease, and its diagnosis and treatment, and provides them with clinical experience of observing patients in endemic areas. Moreover, the diversification of teaching methods stimulates the students' interest in learning, and develops their practical abilities, thinking skills, and cooperation skills.

Integration of formal knowledge with clinical experience

During the on-site teaching, students are trained as interns to master the skills needed to identify and manage the most common clinical presentations associated with *P. skrjabini*. Specifically, they learn how to recognize the different types of *P. skrjabini* infection (e.g. abdominal, subcutaneous migratory mass, and cerebrospinal). In addition, complicated medical conditions such as paragonimiasis require doctors who are resourceful and have the practical ability, comprehensive analytical skills, and clinical application for the work.

Therefore, in the endemic areas, students are also guided in their work using the following four methods: (1) dissemination and consultation of routine health knowledge; (2) performance of a survey of the eating habits of different age groups, and of skin test and serologic examinations; (3) assessment of metacercariae infection in the local river crabs; and (4) a social survey of immigrants into the reservoir areas. As a result of these activities, the students gain an understanding of larva migrans, seizures, cough, and chest pain related to the clinical presentations of *P. skrjabini*, and the program also enhances the students' overall abilities, including their social, cooperation, and, organizational skills; research ability; professional competence; and the ability to apply professional knowledge to solve

practical problems. In particular, we found that this program enhanced the student's innovative thinking and ideas, some of which have been resolved, while others need to be answered by future studies and work.

Enhancing students' knowledge of medical ethics

Medical students are the mainstay of the clinical work, scientific research, and medical education of the future. In order to enhance students' knowledge of medical ethics, students at TMMU have to complete scientific experiments independently, and participate in the on-site placement. For example, for the experimental part of the program, students need to personally design and perform the experiments, and overcome difficulties when experiments do not proceed as planned. Moreover, by visiting endemic areas, the students also recognize that the current level of health care in some areas of China is still less than ideal, particularly in the mountainous areas where there are high levels of poverty, and it is hoped that this might encourage them to participate in social or military service after graduation.

Development and assessment of the teaching method over the years

This teaching method was implemented in 2006, and has undergone significant development since then. To compare its effects with those of our previous non-systematic teaching system, we conducted a questionnaire survey of students at the end of their course. The results showed that 95% of students believed that the systematic teaching system helped them to gain a more comprehensive grasp of knowledge about *P. skrjabini*; 97% liked this diversified teaching method, which stimulated their interest in learning; 90% believed that the on-site teaching can help them understand the community and build a firm sense of service to the community; and 95% believed that the teaching of other subjects could benefit from this model. In addition, according to a survey carried out in the *P. skrjabini* epidemic regions, 95% of the students who graduated from our school continued to

Table 1 Curriculum design for teaching on *Pagumogonimus skrjabini*

Teaching content	Method	Total study time	Aim	Semester
Biology knowledge	Classroom teaching	1 hour	Grasp the basic knowledge of the organism and disease	Fourth
Diagnosis	Performance in the laboratory	2 hours	Master the laboratory diagnosis	Fourth
Scientific research	Scientific research	Spare time	Become familiar with and explore the mechanism of pathogenesis and diagnosis	Fourth to sixth
Clinical medical sciences	Affiliated hospital	2 months	Gain the ability to communicate effectively with patients, collect patient history, and the skills to diagnose and treat	Sixth to eighth
Clinical medical sciences on-site teaching	On-site teaching	1 week	Learn how to treat and prevent disease, and develop a strong ability to think analytically when meeting patients with complicated clinical presentations	Ninth

work as medical doctors, providing medical services to the soldiers and citizens in the local area. They succeeded in diagnosing many *P. skrjabini* cases early, and in increasing the perception and knowledge of this disease among the population. Moreover, some of our students have been the first authors of published research papers on *P. skrjabini*,^{7,8} and some students have participated in the research and development of a *P. skrjabini* clinical diagnostic kit, for which patents have been applied (invention patents in China: (1) the paragonimiasis testing device and its preparation method, patent no. 200810069584; (2) paragonimiasis detection kit and its preparation method, patent no. 200810069585; and (3) the paragonimiasis excretion secretion of recombinant expression vectors, engineered bacteria, preparation method, and its application, no. 200810069914). Furthermore, the on-site teaching and epidemiological investigations have provided certain social benefits such as social surveys and examination of the paragonimiasis epidemiology of reservoir resettlement. These projects have supplied reference data for the local Three Gorges water conservancy construction and water conservancy project on changes in the local ecological environment, and provide a theoretical basis for government and health sector about planning and decision-making on public health.

Conclusion

We investigated a novel teaching system, incorporating classroom teaching, laboratory work, and on-site experience to train students in the diagnosis, treatment, and prevention of paragonimiasis. This project

has proven very successful, and continues to be used for teaching students about *P. skrjabini*. In order to improve it still further, we are aiming to increase the amount of field teaching used.

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