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# Pharmacology teaching and its reform in China

Wei-dong LI<sup>1</sup>, Yuan ZHANG<sup>1</sup>, Cai-li ZHANG<sup>2</sup>, Xiu-mei ZHANG<sup>3</sup>

<sup>1</sup>Department of Pharmacology, Peking University, Beijing 100083; <sup>2</sup>Department of Pharmacology, Tianjin Medical University, Tianjin 300070; <sup>3</sup>Department of Pharmacology, Shandong University, Ji-nan 250012, China.

**KEY WORDS** pharmacology teaching; reform; principles and practice of teaching

## ABSTRACT

The general situation of pharmacology teaching in China was introduced and the educational reform in China in recent decade is summarized. The aim of the article is to provide those who are interested in teaching of pharmacology to be acquainted with the teaching of pharmacology, including the teaching of both principles and practice, in China.

## INTRODUCTION

Pharmacology is a key course among a number of preclinical courses in the schools of medicine, nursing, preventive medicine, dentistry, pharmacy, *etc*, in China. Through half-year study, students can acquire the basic knowledge of the fundamental principles of pharmacology and its clinical applications, the basic skills in doing pharmacology experiments, know the professional knowledge of the laws and regulations of drug administration. And students could have the basic ability to perform scientific research in pharmacology.

Reform in pharmacology teaching has been carried out for about one decade in Chinese universities. An attempt is made to highlight the importance of research-oriented education and problem-based learning in medical schools. Chinese Pharmacological Society concerns very much on the teaching of pharmacology. Seminars on pharmacology teaching have been convened every 4 years. Topics such as “Current status of pharmacology discipline”; “Trends in the teaching of pharmacology”; “The qualification of teachers of phar-

macology” “Technique of lecturing”, *etc*, were the themes for the discussions.

The current status on pharmacology teaching in China is reviewed as below:

## TEACHING OF PRINCIPLES

**General situation** The pharmacology course started in the first semester of the third year, teaching the medical students general and basic systematic principles on pharmacology. As the bridging discipline connecting basic medical sciences and clinical sciences, pharmacology lectures were integrated with lectures of pathology and pathophysiology. While in the traditional teaching the students were taught in a series of preplanned pharmacology lectures, that was teacher-centered teaching.

Drugs acting on a particular system of the body and their clinical application will be put together in a series of lectures. Major lectures are focused on drugs acting on the peripheral autonomic nervous system, such as the central nervous system, the cardiovascular system, the endocrine system, chemotherapeutic agents, and miscellaneous drugs. Students are expected to understand principles of pharmacodynamics and pharmacokinetics such as the mechanisms of action of drugs producing therapeutic or toxic effects, the factors in-

<sup>1</sup> Correspondence to Dr Wei-dong LI. Phn 86-10-8280-2798.  
Fax 86-10-8280-1686. E-mail [lwdpharma@126.com](mailto:lwdpharma@126.com)  
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fluencing their absorption, distribution and biological actions, by which the relative potencies and duration of action of drugs are determined, and the experimental evidence on which these hypotheses are based on. In addition, students will be given some indication of how new drugs are developed and tested. The real objective of teaching is to help students master the knowledge contained in each lecture and to prepare for examinations scheduled at the end of each subject. Generally, forms of examination are block examination.

**Education reform on academic teaching** To implement quality education and develop modern science and technology in China, reforms of undergraduate pharmacology teaching has been carried out about one decade. An attempt being made to highlight the importance of research-oriented education and problem-based learning to medical schools in China. The teacher-centered activities, in certain circumstances, are converted to students-centered activities. The course of pharmacology consists of a combination of lectures, problem-based learning sessions, clinic-correlated lectures, and small group discussions. Teaching objectives for each contact hour have been developed and are posted on-line. Other modifications include multimedia CDROM/web-based computer-assisted learning (CAL) programs; problem-based learning (PBL); bilingual teaching; change of examination activities and evaluation system, etc.

**Multimedia CDROM/web-based computer-assisted learning (CAL) programs** Computer-aided multimedia teaching is extensively used in all aspects in pharmacology teaching. By the help of computer technology, e-resources on pharmacology are increasingly to support or replace traditional teaching methods. By the help of information, general strategies about how teachers can get information from web sites and how to use the information successfully have been provided in some universities. The concepts in pharmacology and the effects of drugs can also be described electronically<sup>[1,2]</sup>. The computer is a useful tool for both teaching and learning in medical education. It is unlikely that media platform exerts any influence on reliability or validity of scientific data. However, using computer appropriately can be of considerable educational benefit and will serve medical professionals throughout their career. Information technology, however, must not be viewed as a potential cure to the current ailments of medical education.

A modern library places an increasing amount of its material in electronic format and increasing number

of journals are available either on CD-ROM or over the Internet. This represents a considerable saving in storage space and manpower. Teachers can now encourage their students to use library facilities in electronic fashion, and often at their own home. If the financial problem can be solved, then it is likely that computer, combined with the Internet and CD-ROM will be useful educational tools in most medical colleges in China.

Another educational concept is distance education. Although not new, distance education has entered in a new era with the advent of internet and multimedia teaching. The majority of students who participate in the distance education are working adults who need flexible hours for study, and distance education meets the needs. This way of learning is highly recommended because the students may be able to study at their own pace and time. The students will earn a junior college's or bachelor's degree. The students will learn from instructors who hold advanced degree in pharmacology and other courses. As a top health science college in China, Peking University has established a distance education college for 3 years and expected to give students a future rewarding career in medicine.

**Problem-based learning (PBL)** The primary objective of the course is to build an ability of the students to improve themselves and to learn the principles of pharmacology with a critical mind. Particularly, we hope that students will develop skills to identify key elements of scientific problems in pharmacology, to determine the essential information needed to attack those problems, to seek out and find that information, to clearly and concisely discuss the findings with their peers, and to work together to make comprehensive experimental approaches to solve the problem. The traditional lecture-based teaching has been criticized as lacking the ability to arouse the enthusiasm of students and bring forth new ideas. Indeed, after 20-min lecture, most of the students will have lost concentration and will not absorb any more information. Didactic teaching activities are usually passive and is easy to forget. Due to the multiple disadvantages of traditional teaching, education reform is necessary. A dominating reform is problem-based learning advocated by Dr BARROWS, McMaster University in Canada<sup>[3-5]</sup>. The PBL project emphasizes on self-directed learning. Students come with recommended textbook to the class and are divided into small groups. Each student is asked to answer questions related to a given case. Often the condition of the case is not as typical as stated on the textbook. Students should design a plan of medica-

tions for the case. Open book examinations become predominant. In this way students are required to learn not only principles of pharmacology, but also the application of principles to patients. Rather than just remember and recite a lists of side effects, for example, this way of learning requires students to utilize the knowledge of side effects list to choose suitable medicines and inform patients to deal appropriately with the medication for them. By using this method in pharmacology teaching, the ability of students to solve problems has been obviously improved. FENG Guo-qing<sup>[6]</sup> compared the effectiveness of problem-based learning (PBL) and classical lecture-based learning (LBL) in a general pharmacology class of third-year medical students ( $n=293$ ). At the end of the semester all students received a questionnaire and participated in the same 30-question multiple-choice examination. The mean score was  $77.13\pm 6.7$  and  $73.24\pm 7.6$  points in the PBL and LBL groups, respectively ( $P<0.05$  in a two-tailed *t*-test). In this questionnaire, student evaluation for PBL method is extremely positive. Therefore, pharmacology should be presented consistently across the curriculum, able to foster student self-learning, and able to provide feedback to both students and professors.

**Bilingual pharmacology teaching** Facing the fast development of science technology, knowledge and information, with the open policy and China becoming a member of WTO, there are increasing international cooperation between China and other countries. Mastering professional knowledge in foreign languages, especially English, appears very urgent. Therefore, in "Several Suggestions about Strengthening Undergraduate Teaching and Improving Teaching Quality", which was issued by China National Ministry of Education in 2000, it explicitly pointed out that not less than 20 % of the courses for medical students should be lectured with Chinese and English bilingually. A pharmacology bilingual teaching model, hence, has been set up in many medical colleges. The goal and advantage of bilingual education have been recognized in China. Because of lacking English speaking environment, China-born students must learn to use English terms in pharmacology, and to learn and develop the skill enabling effective communication in English in an international environment.

Taking Tianjin Medical University in China as an example, for seventh-year medical students, Department of Pharmacology in Tianjin Medical University has performed for many years the following teaching activities: Compiling a pharmacology text book in English according to the planned teaching content and newly published

English and Chinese Pharmacology text books. The text book is designed to provide a comprehensive, updated, and easy to read pharmacology text book both for seventh-year and foreign medical students. The book was published in 1997 (1st edition), 1999 (2nd edition), and 2002 (3rd edition). This text book has been also used by Medical Schools of Nankai University and Henan Medical University. After using this book for several years, it shows itself as a practical, high quality basic science teaching material. In 2000, pharmacology experiment guideline in English (3<sup>rd</sup> edition) was compiled. In 2003, a review test book in English was written. It includes multiple choices, filling the blanks, answering the questions. From 1985 till now, pharmacology lectures have been given in English persistently by some professors. Pharmacology examination paper is in English and students are asked to answer the questions in English. To improve teaching quality, they used elicitation method of teaching; prepared lectures collectively and linked pharmacology principles with clinical practice in order to foster students' creativity. To improve students' English level, they instructed students to write abstracts and reviews in English. Foreign professors had been invited to give lectures and seminars. Faculty members and students, hence get acquainted with current trends in pharmacology. To elevate the ability of young teachers, teaching assistants and graduate students, were asked to read original English pharmacology text book once a week for 1.5 h. Department of Pharmacology in Tianjin Medical University had continued such training for more than 20 years. The listening comprehension, reading, speaking and writing ability of teachers and students in the department have thus been raised. Young teachers were trained to give pharmacology lectures in English and are encouraged to present papers in English when they attended academic meetings. In 1999, pharmacology text book in English received a 1<sup>st</sup> grade award given by Tianjin Medical University. In 2000, Pharmacology teaching model for seventh-year medical students got 2nd grade award given by Tianjin Municipal Committee of Education.

A survey of bilingual teaching among undergraduates majoring in clinic medicine has been carried out to evaluate the students' attitude toward bilingual teaching, to seek for appropriate methods of developing bilingual teaching and to find out factors related to development of bilingual teaching. The results of the structured questionnaires were analyzed with SPSS statistical software<sup>[7]</sup>.

**Change of evaluation system and examination activities** For a long time, the word “assessment” simply means a process of assigning students grades. However, the meaning of assessment is much more than this. Assessment is a mechanism for providing instructors with data for improving their teaching methods and for guiding and motivating students to be actively involved in their learning. As such, assessment provides important feedback to both instructors and students. Assessment gives us essential information about what our students are learning and about how far we are meeting our teaching goals. But the real role of assessment is to give feedback to our students. So that the quality of learning in our courses could be improved right after each assessment not till at the end of the course knowing what the students have learned.

Traditional testing methods limited the scope of testing student learning, and equally important, is of limited value for guiding student learning. These methods are often contradictory to the increasing emphasis being placed on the ability of students to make analytical thinking, to understand and to communicate. There is considerable evidence showing that assessment drives student learning. Even many teachers often discover that their students have not learned what they are trying to teach and that much of what students have learned will be quickly forgotten after the final examination. Moreover, because assessment in many aspects likes a glue that binds the components of a course, changes in the structure of a course require corresponding changes in assessment. Therefore, we consider that the assessment system for pharmacology teaching is very important.

Traditional pharmacology examination formats in most medical colleges in China were filling blanks; multiple choices; judging; explaining terms; question-and-answer drills, *et al*, in block examination. The advantages of the format are objective, fair, and touching upon wide range of knowledge. However, the disadvantages of the format are decreasing students learning enthusiasm; inducing learning by rote; being lack of flexibility in using what they have learned. The contents of test commonly used in many colleges after reform test questions are selected randomly from a computer; combining test with writing scientific paper or review or topics concerning advancement, *et al*. A new format on examination has been spreading, that is separation of teaching and exam<sup>[8]</sup>. There is a survey reported by the Third Military Medical University. The questionnaire tested 268 students of the 1999th class. The title

is “Do you like the method that open examination immediately after analysis of drug application in clinical practice?” The results are shown in the following Tab 1:

**Tab 1. The attitude of students in 1999th grade on opening examination after analysis of drug application in clinical practice.**

Class	Total students	Those approved open book examination	
		Number	% in class
Clinical medicine	144	87	60.4
Preventive medicine	70	89	55.7
Inspective medicine	54	30	55.6

The results showed that over half of the students approved the style for examination.

Fu *et al*<sup>[9]</sup> introduced the examination according to the characteristics of pharmacological examination of national examination database and its impact on the undergraduate pharmacology teaching. It was found that in this way the limitation in teaching and learning could be diminished and teaching activities could be improved. The number of quiz was increased and the contents of quiz mimic the characteristics of national database of pharmacology examination. The survey showed that through the practice, the average score of the examinations using national examination questions increased year by year. And the scores of three classes of students were in normal distribution by  $\chi^2$  test, that were  $65.5 \pm 7.7$ ,  $68.2 \pm 7.1$  and  $68.6 \pm 8.3$ , separately in three years.

The teaching course has been designed as disease-case discussion sections. Disease-based learning was used in pharmacological teaching and pharmacological examination. During these informal sessions participants are invited to present and discuss personal cases with their colleagues. One type of examination questions is disease-case analysis in some colleges. It is very useful for students to have a good grasp of what they learned in pharmacology. The assessment includes: oral introduction 10 %, final oral presentation 30 %, project design and thesis (final report) 60 %<sup>[10,11]</sup>.

## TEACHING OF LABORATORY EXPERIMENTS

**General status** Experimental practice of pharmacology is an important part in the educational activi-

ties of pharmacology in medical colleges in China. It aims to teach undergraduate students to practice laboratory skills. The practical work consists of a series of individual experimental teaching the students to design experiments and learn experimental techniques. Experiments include work on mice or other animals *in vivo* and work with isolated tissues *in vitro*. The course will help the students to understand how drug acts and the consequences of drug-receptor interactions.

#### **Reform in teaching of experimental practice**

Education reform of laboratory teaching in China has been carried out for several years. Experimental pharmacology are integrated with theoretical pharmacology, and in general, related to the problem-based learning tutorials. In some colleges, the laboratory course teach students to design experiment and carry out small research projects using modern experimental methodology. Computer simulations of laboratory practice on an intranet or the internet are also carried out in some colleges. A new modality called integrated laboratory has been set up on pharmacological laboratory courses as explained below.

**Computer simulations of laboratory practice using intranet** Financial support is needed to build a computer suite with the necessary technology and appropriate software. Students were provided with self-learning computer instruction that use a unique, designed graphical symbol language to explain problems of clinical pharmacology at organ and cellular level in the process of physiological or pathophysiological changes. In this course, students could use the given computer database to do assignments<sup>[12]</sup>. A D2951 super experiment station has been set up<sup>[13]</sup>. D2951 system is a computer assistant system compatible with DOS for teaching of experimental pharmacology. The system takes Windows interphase and can simulate experiments procedures. It is easy to learn and master. It meets the need for pharmacology experimental teaching. A computer-assisted design system MS302 was used to measure and record the curve and data collected from the pharmacological experiments. These include the calculation of  $pD_2$  and  $pA_2$  values on dose-effect curve of drug action, the effect of cardiac glycoside on isolated frog heart, effect of oxytocin on isolated uterine in mice, and anti-arrhythmic effect of lidocaine, and so on. The system has a lot of advantages. It improves the quality of original record and photograph; the curves obtained could be enlarged and compressed; the data could be edited, printed, and stored. It is compatible with office software<sup>[14]</sup>.

**Self-designed test** In self-designed test, teachers tell the students the basic principles and procedures in designing experiments. Then students go and find out relevant reference materials through library or internet, and give an overall scheme about experimental design after discussion in groups. Teachers may give some advice in this process. Then, students carried out their plans using equipments, agents, drugs, and animals in the laboratory and decide whether the results are expected and write the experimental report. Through the experimental design, students will understand the general process of scientific research. Through this experience, their ability of looking for reference and solving problems are greatly improved. It can also broaden their vision, activate their thinking, and enrich their scientific research ability<sup>[15]</sup>. In this class, some of the experiments were designed to combine with the research and development of new drugs. It can increase the chance of practice and save outlay. The students could master the experimental technique and at the same time arouse their enthusiasm in doing experiments. It can also improve students' ability to present their experimental data accurately and clearly by the use of appropriate computer software<sup>[16]</sup>. After finishing the course, students will be able to conduct simple experiments on *in vitro* preparations and present their findings in a written form including details of the background of the experiment (introduction), methods, results and discussion. They will understand what tissue preparations can be selected to examine particular physiological systems, for example, smooth muscle can be used to study  $Ca^{2+}$  channels. They will also learn the knowledge of animal welfare and ethics related to the use of animals in medical research<sup>[17]</sup>.

**Case discussion** In general, tutors select some typical clinical cases and distribute them to students in advance. Students then go to reach related materials from library and/or internet to make a correct diagnosis according to the symptoms, physical signs, and laboratory results of the case. Then the students can further analyze the pathogenesis and etiology of the case and decided on a plausible therapeutic regimen. Finally, they can give a proper therapeutic plan based on the pharmacological knowledge they have learned. During this process, both the teachers and the students can raise questions about the case and solve the problems via analytical discussions. Case discussion connecting basic sciences with clinical sciences could greatly enhance the students' interest to learn pharmacology. At the end of the case discussion, the aim of this case discus-

sion and the correct answers will be given. Students should briefly provide feedback on the discussion and the answers.

**Setting up a multifunctional laboratory** A new modality called integrative laboratory has been set up in pharmacological experimental class in many colleges in China. It is designed to integrate three experimental courses, *ie* experimental course on pharmacology, physiology, and on patho-physiology. The students only need to attend one of the course. The advantages of setting up the integral laboratory are: (1) experimental resource can be used economically and efficiently; (2) class hours can be reduced. Aboration period had been reduced by 43 % from 96 to 54 h; (3) more chances for students to have hands on practice; (4) the repetition contents of the three courses can be eliminated; (5) advanced equipments can be utilized effectively and efficiently<sup>[18]</sup>. After the establishment of integrative laboratory, the laboratory resources are re-distributed so that, some modern equipments could be purchased. The old recording equipments such as kymograph, electrocardiograph are now replaced by biofunctional recording system such as MS302, BL-310 and Powerlab, which have many advantages and can record original data and edit, calculate, analyze the experimental data. Some laboratories are equipped with multimedia projector and material object table, which provide condition for multimedia teaching. Some laboratories even build local computer work, which make internet teaching possible.

The setting up of integrated laboratory matches experiment teaching with principles teaching of pharmacology, physiology, and pathophysiology. The integrated lab offers an alternative environment for the learning of selected topics in basic and systematic pharmacology and related subjects. Students can develop experimental skills better.

**Conclusion** Pharmacology teaching in medical colleges in China has been improved rapidly in recent years due to the development of modern teaching tools and the practice of bilingual teaching. At present, pharmacology faculties are pursuing different formats of reform that undoubtedly will raise the whole educational quality for medical students in China.

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