Modification of A Traditional Pharmacology Curriculum

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Introduction

Historically, the Medical Pharmacology course at the University of South Carolina School of Medicine has been a traditional course with 100 lecture hours, several clinical correlations, multiple case studies and small group conferences. Motivated, in part, by the GEP report (AAMC report on General Professional Education of the Physician) and by the increasing interest in problem based learning (PBL) at our institution, we re-evaluated our course with a focus on the type and number of drugs being presented and on the relevance of the information as it related to the clinical practice of medicine. Students indicated that they were spending large amounts of time just learning the names of drugs at the expense of learning principles and prototypic drugs.

A review of our 1991 course syllabus revealed that we covered over 400 individual compounds. Although the course was based on a discussion of prototypic drugs of each class, additional drugs were included in the material required of the students. In numerous cases, drugs were required learning, based on a difference in pharmacokinetics or some single difference in side effect profile. For example, seven β-adrenergic blocking agents were included in the course. Nadolol was included based only on the longer half-life and method of elimination (unchanged in the urine). Additionally, three β₂-adrenergic receptor agonists were introduced in the autonomic pharmacology section of the course.

As a result of this review, the course was redesigned based on the premise that this was an introductory course in Medical Pharmacology. For most of the students this was their first course in Pharmacology. It was recognized that we could not cover all the drugs to which students would be exposed in the clinics. It was also decided to focus more on concepts of drug action and less on a survey of the many drugs available for clinical use. Faculty were encouraged to present the basic pharmacology in a conceptual framework as it relates to the clinical practice of medicine. This focus on clinical relevance has been accomplished by the use of mini-case studies within each lecture, clinical correlations, faculty-directed case study presentations, and small group discussions.

Changes

1. General Principles: Increased emphasis is placed on the general principles section of the course. In addition to the previous material in General Principles, it is emphasized that while we will focus on only one prototype drug, each drug class included many individual compounds that varied mainly in pharmacokinetic characteristics. The importance of the route of elimination (i.e., kidney versus liver) is stressed as a factor in individual drug selection from within a group. Also the importance of rate of onset and duration of action are emphasized relative to dosing schedules and compliance. Students are made aware of the pharmacokinetic differences that will influence the choice of a given drug from within a group. By providing a solid foundation in these general principles and the rational clinical selection of agents based upon the same, students are equipped with the requisite tools for self-education regarding the multitude of drugs to which they will be exposed in their future clinical years.

2. Reduced Number of Drugs in the Course: Each instructor in our course was requested to focus lectures on principles of drug action and prototypic drugs. In order to minimize the number of drugs, in addition to the prototypic agent, exclusion criteria were established by our faculty to reduce the number of drugs presented in the course. First, any drugs that were being presented solely on the basis that students may “see it used in the clinic” or that it might appear on the USMLE-Step 1 licensing exam were deleted. Secondly, any drugs where the clinical indication was rooted in marketing versus science were eliminated. Thirdly, drugs that were of historical interest only, even though they may exemplify a basic pharmacological principle, were removed. Lastly, any drugs which differed only in a pharmacokinetic characteristic or a slightly different side-effect profile were to be removed unless such differences represented the essence of the rational clinical selection of the class of agents. Through an evolutionary process, applying these criteria, the number of drugs in the course has changed from over 400 agents in 1991 to about 250 agents in 1997. By contrast,
the AMSP (Association for Medical School Pharmacology) drug list contains 300+ compounds as primary drugs and an equal number designated as “secondary” drugs. As would be expected, our current list of 250 drugs includes several new agents with unique pharmacology that have become available since 1991.

Examples of changes applying our exclusion criteria are as follows: (1) The number of β-adrenergic antagonists was reduced from seven to two [non-specific β-blocker - Propranolol; “cardio-selective” β-blocker - Metoprolol]. (2) The number of β₂-selective agonists was reduced from three to one [Albuterol]. (3) The deletion all sedative-hypnotic barbiturates and the lecture presentation of these agents. (4) A reduction in the number of benzodiazepine sedative-hypnotics from seven to three [Diazepam, Lorazepam, and OXazepam]. (5) The number of antidepressants [TCAs + SSRIs] was reduced from seven to three [Amitriptyline, Nortriptyline, and Fluoxetine]. (6) The number of antimicrobial/antiparasitics/antivirals was reduced from 85 to 50 agents.

3. Mechanism of Drug Action: As a basis for discussion of mechanisms of drug action, several major sections of the course are opened by a review of the relevant physiology, biochemistry and/or pathology. Specifically, reviews are presented prior to autonomic, cardiovascular, renal, CNS and antimicrobial/cancer chemotherapy pharmacology. A discussion of the physiological (or biochemical) basis for drug action provides the student with predictive value about drug responses as well as presenting a review of important points of the basic sciences. The integrative nature of pharmacology helps the students bring together the various aspects of the biomedical sciences and more fully appreciate and understand the importance of the basic science years.

In addition to providing the students with a clinical context for knowledge that they obtained in other courses in their basic science years, our course is internally integrative insofar as students are expected to be able to apply concepts acquired in previous sections of the course. This philosophy has decreased the time faculty had been spending on “reiteration” of previous material. It also minimizes the tendency of students to “learn” and then “forget” and fosters the ideal that medical education is not an isolated collection of facts but a continuum of information required to deal with the complex problems in clinical practice. Student learning patterns are modified as a consequence and our assessments (i.e., examinations) of students are designed, in part, to measure the success of such learning modifications.

4. Clinical Relevance: A fundamental tenet, emphasized to all participating faculty in our course, is that this is a course in Medical (not graduate) Pharmacology. Thus it is essential to provide a meaningful clinical context for the information being acquired. Since most of our faculty are Ph.D.’s without any medical experience they are encouraged to acquire knowledge of the clinical significance of the material being presented. In this respect, numerous opportunities exist for faculty development. Notices of Grand Rounds, lunchtime clinical conferences, and other presentations in the clinical departments are made available to our faculty and texts on clinical use of drugs are purchased for our departmental library. One faculty member took a full 8-week clinical rotation in neuropsychiatry in the M-III curriculum to better present the material in the CNS Pharmacology section of the course. In addition, clinical faculty critique faculty through review of their lecture syllabus and by attending their lecture series.

It is our judgement that this is of even greater importance today, as more and more of our faculty are from training programs other than pharmacology. For those individuals trained in biochemistry, molecular biology, or neurosciences it is important for them to gain an appreciation for both the pharmacology and its clinical significance if they are to make a significant contribution to the training of medical students.

It is also felt that there is a developing need for Medical Pharmacology courses to include more therapeutics as essential content in the preclinical years. This need has arisen from the increasing demands placed on clinical faculty toward patient care with a corresponding reduction in time available for undergraduate medical education. The necessity of incorporating therapeutics as an integral component in our course will be facilitated by and a natural extension of the emphasis on clinical relevance.
of pharmacology as it relates to the practice of medicine.

Outcome

The changes that have been implemented have produced enthusiastic appreciation by most students taking our course in Medical Pharmacology. Although recognized by students as the most challenging of the basic science courses, students have consistently rated it as one of the “best”, if not the best, course in the basic science curriculum. In the only two instances where a class has chosen to designate a “Course of the Year”, Medical Pharmacology has received the honor both times. Additionally, post-graduate year-1 [PGY1] evaluations of our graduates indicates that Medical Pharmacology remains as one of the highest rated academically relevant experiences in the students entire 4 years (including all clinical rotations) of undergraduate training at our institution. Student performance on the pharmacology portion of USMLE-Step 1 has been above the national average for every year (1991-1997) since the introduction of these changes. It should be noted that performance on USMLE-Step 1 in some of the other basic sciences have declined during this time. Additionally, anecdotal feedback from M-III / M-IV students has indicated that our course was “highly-relevant” to the clinical practice of medicine.

Through the evolutionary process of implementing these changes, and through future changes that incorporate therapeutics, we feel that many advantages have been realized, but we have also been confronted with potential drawbacks of our desire for change. Some advantages realized through the changes made in our Medical course are:

1. By limiting the number of drugs covered in the course, the requisite vocabulary the student must memorize was reduced. This has provided faculty more time to cover general principles and concepts and allows the student to focus more on concepts essential for problem-solving.

2. The increased emphasis on clinical relevance versus scientific curiosity has resulted in heightened enthusiasm by the students and fostered a sense of “importance” to the information being presented.

3. Student learning has been modified from one emphasizing “memorization and recall” to one requiring recognition and application of information to solving novel clinical problems.

4. Within the confines of a traditional curriculum, students develop more fully a competency and motivation to become self-directed learners.

Some drawbacks that have or could arise from our changes include:

1. This approach has required more time and dedication on the part of the faculty. They must devote the time to reconstruct their lecture presentations emphasizing a limited number of drugs, side-effects, etc., while maximizing the clinical relevance of the material presented. The education efforts and achievements of faculty, who take the time to select drugs to be covered and obtain clinical knowledge, like at most institutions, go largely unrewarded in the areas or salary, promotion, and tenure.

2. In limiting our required drug vocabulary, students could likely encounter drugs in either the clinics or on USMLE-Step 1 with which they are unfamiliar.

In Summary

We have developed a challenging and comprehensive course in Medical Pharmacology that is based on general principles and concepts with a restricted drug list of approximately 250 drugs (this list is not distributed to the students). This is accomplished by focusing on one or two prototypic drugs in each area. Within the limits of faculty initiative, the basic principles and concepts are presented in a manner relevant to the clinical practice of medicine. An extension of the emphasis of clinical relevance is the increasing incorporation of therapeutics into the course.