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CASE-STIMULATED LEARNING WITHIN ENDOCRINE PHYSIOLOGY LECTURES: AN APPROACH APPLICABLE TO OTHER DISCIPLINES

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The problem of presenting endocrine physiology lectures in a format that interests medical students was addressed. Incorporating truncated case-stimulated learning sessions into the lectures has proven to be a successful solution to this issue, while also providing continuity between topics in the lecture block. This method of providing a direct clinical link for basic physiological concepts and providing a more active learning experience is adaptable to most basic science disciplines.

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Providing first-year medical students with a strong introduction to basic human function is difficult without overwhelming them with information for which they perceive no relevance until later in their clinical training. I have worked to find solutions to these universal difficulties since joining the faculty of the Department of Physiology at the Tulane University School of Medicine in 1980. Past efforts to alleviate this situation have included trying to provide relevance by appending clinician lectures to the basic curriculum, but that approach often suffered from a lack of coordination with standard lecture topics. Moreover, these clinical correlation lectures did not solve the problem of captivating the students' interest during the remaining 90% of the lectures. In the endocrine block, the dual approaches of introducing lecture topics with slides of patients with classic endocrine disorders and sprinkling clinical anecdotes into the lectures are somewhat helpful, but they also did not provide a satisfactory solution to this problem.

Recently, there has been a trend at many institutions to reduce the number of lecture hours and provide more instruction through small-group problem-based learning (PBL) sessions (5). Since this teaching motif was introduced into the department curriculum, it has been principally substituted for the afternoon laboratory exercises. Thus, whereas some overlapping lectures have been eliminated, most of the physiology course continues to be presented to students in lecture sessions. Because a significant number of students learn well from lecture presentations, this approach of presenting material using both the PBL and lecture styles may be a good blend of these teaching modalities.

However, incorporating small-group PBL sessions into the curriculum as an adjunct to the lecture sessions did not solve the important problem described above: the seeming lack of relevance to the students of the lecture material. Five years ago I began using the approach of incorporating what I think of as truncated PBL sessions into the endocrinology physiology lectures. This approach shares some aspects of whole class active learning techniques, discussed elsewhere (2, 6, 7). This case-stimulated method of providing a direct clinical link for basic physiological concepts

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and providing a more active learning experience has been very well received by the students and has now been adopted by the entire medical physiology course.

THE ENDOCRINE PHYSIOLOGY BLOCK: GENERAL STRUCTURE

The medical physiology course at Tulane has been similar to that in many medical school departments, with a strong emphasis on lecture sessions. Moreover, redundant topics are increasingly being eliminated from this and other courses. The textbook for the physiology course has varied through the years, with the preference being to select a single universal text instead of recommending a selection of monographs. The endocrine block comprises the final section of the second-semester medical physiology course, coming at a time when the students are well exhausted from their first-year curriculum. With the exception of reproductive physiology, endocrine physiology has been principally my responsibility throughout my tenure at Tulane. This block is rather traditionally designed, as indicated in the list of one-hour-long lecture topics in Table 1.

There are usually two sets of afternoon sessions for the endocrine block, and each is done twice during the week, involving one-half of the freshman student body each afternoon. Currently, there are two endocrine-related afternoon PBL sessions, both of which were introduced in 1995 and involve thyroid and diabetes patient problems.

TABLE 1
Endocrine physiology lecture sessions

1) Hormone Structure and Function
2) Anterior and Posterior Pituitary
3) Growth Hormone and Somatomedins
4) Thyroid Hormones I
5) Thyroid Hormones II
6) Adrenal Cortex: Glucocorticoids
7) Hormonal Control of Calcium and Phosphate Metabolism: Parathyroid Hormone
8) Hormonal Control of Calcium and Phosphate Metabolism: Vitamin D
9) The Endocrine Pancreas
10) Hormonal Regulation of Blood Glucose and Homeostasis

Except for the first two lectures, the order of these topics in the lecture schedule is adjusted to accommodate alternate lecturers or to ensure presentation of essential background material before afternoon sessions.

CASE-STIMULATED LEARNING IN ENDOCRINE LECTURE SESSIONS: STRATEGY

As predicted, the student responses were very enthusiastic when the initial afternoon PBL sessions were added to the physiology curriculum a number of years ago. From these experiences, I began to consider ways of expanding student exposure to similar clinical problems in more time-constrained situations. I also sought to fulfill the goal of providing more continuity within the endocrine lecture block, in part to assist the students in using and learning information from the lectures in clinical contexts. The approach selected accomplishes all these goals in a rather simple fashion.

Each lecture is introduced with one to three ''patient problems'' presented either as slides or overhead transparencies. These clinical scenarios are very simplified versions of cases taken from journal articles or published case compendiums. Thus simplified, they contain only the minimal clinical information necessary to illustrate selected physiological concepts from the daily lecture. Moreover, medical jargon—which fascinates the students but delays the class and distracts from the basic physiology that the problems are selected to illustrate—is eliminated from the problems.

At the beginning of the class, each case is projected and described for the students. When possible, slides of patients with similar disorders are used with the case to enhance student interest. Usually the case narrative contains some descriptive information about the patient history, followed by some data from the clinical examination and/or laboratory results. Finally, several questions are listed after this information, and these are posed to the students with the comment that they will be able to answer them from the information in the lecture. After the traditional lecture, the patient problem(s) is again projected. The instructor moves into the student seating area and poses the original questions to them, using their responses, correct and incorrect, as a mechanism to highlight physiological concepts from the lecture. When time is limited, the students are encouraged to use some of the questions listed in the problems as study questions.

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TABLE 2
Diabetes mellitus with high insulin levels I

Patient
51-year-old man
Diabetes mellitus (hyperglycemia, with decreased alertness, withdrawal, irritability, and sleepiness, especially 2 h postmeal)
Not obese
Laboratory data
Fasting hyperglycemia (140–170 mg/dl)
Hyperinsulinemia (70–120 μU/ml)
Questions
1) What are the possible causes of this disease?
2) How would you test for each of them?
3) How would you treat in each case?

Adapted from Given et al. (3).

TABLE 3
Diabetes mellitus with high insulin levels II

Patient
51-year-old man
Diabetes mellitus (hyperglycemia, with decreased alertness, withdrawal, irritability, and sleepiness, especially 2 h postmeal)
Periodic episodes of weakness
Exam
Height and weight normal
Blood pressure 120/82
Renal function normal
Neuromuscular function normal
Brother with diabetes
Father died at age 62 of myocardial infarction
Brother and sister with undiagnosed neuromuscular diseases
Laboratory data
Fasting hyperglycemia (140–170 mg/dl)
Hyperinsulinemia (70–120 μU/ml)
GH/cortisol/glucagon normal
Questions
1) What are the possible causes of this disease?
2) How would you test for each of them?

Adapted from Given et al. (3). GH, growth hormone.

Example I: Diabetes mellitus with high insulin levels. An interesting case of diabetes from an extensive article in the *New England Journal of Medicine* (3) is used several times in the endocrine lecture block.

The first lecture, ''Hormone Structure and Function,'' includes examples of hormone and prohormone structures, the various factors that contribute to hormone levels and function (from tropic stimuli to rates of hormone synthesis/secretion, differences in clearance, and competence of receptor mechanisms), and definitions of frequent sources of endocrine disorders. For this lecture, the diabetes case is presented in a very simplified version (Table 2). The discussion after the lecture quickly reminds the students of the paradox of having hyperglycemia in the face of high levels of detectable circulating insulin and emphasizes the question of the possible causes of the disease. Students are usually quick to answer that there might be a receptor defect, which is an excellent answer but is in fact not this patient's problem. Other likely answers that illustrate points from this or later lectures include the presence of inactivating insulin or receptor antibodies, problems with the glucose transport mechanism, abnormalities of other glucose regulating hormones, and, correctly, the presence of an abnormal insulin molecule (uncleaved C-peptide).

In the later lecture, ''The Endocrine Pancreas,'' a more involved version of the case is presented (Table 3), with a reminder that the case was introduced in the first lecture. This time, the case is constructed to emphasize aspects of the patient's symptoms and family history that are important in physiological consequences of diabetes mellitus. As these symptoms are pointed out after the lecture, the students are asked what their relevance is to the patient and his disease.

The final lecture, ''Control of Blood Glucose Levels,'' emphasizes the interactions of insulin and the other glucose-regulating hormones in a variety of physiological states. The case as described in Table 3 is used again, this time to explore the reasons for considering alterations in other glucose-regulating hormones as contributors to the patient's condition.

Example II: Adrenal disease. A straightforward case of adrenal disease is taken from an extensive collection of patient descriptions (4). The case is first used in the second lecture, ''Anterior and Posterior Pituitary,'' (Table 4). At the beginning of the class, the students are asked to answer the first question, which reminds them of the discussion on circadian patterns of hormone secretion from the introductory lecture the previous day. By the end of the lecture, the students can answer questions about the significance of the adrenocorticotropic hormone (ACTH) stimula-

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TABLE 4
Adrenal disease I

Patient
37-year-old woman
Severe weakness, increased pigmentation, weight loss, chronic illnesses
Laboratory data
Serum cortisol, 1 μg/dl (normal 8:00 AM, 9–12 μg/dl)
ACTH, 310 pg/ml (normal 8:00 AM, 30–120 pg/ml)
Questions
1) Why are the hormones measured at 8:00 AM?
2) What are the possible causes of this disease?
3) How would you test for them?
More laboratory data
TRH elevated
ACTH-stimulated cortisol, 1 μg/dl
Dexamethasone suppression test, lowered ACTH
Final question
4) What is the diagnosis and how would you treat?

Adapted from Hershman (4). ACTH, adrenocorticotropic hormone; TRH, thyrotropin-releasing hormone.

TABLE 5
Adrenal disease II

Patient
37-year-old woman
Severe weakness, somnolence, fatigue
15-pound weight loss (4 mo), nausea, abdominal pain, only able to retain liquids
Light-headedness, palpitations, fullness in ears
Increased freckling, other pigmentation
Exam
Chronically ill
Blood pressure 100/60
Normal tendon reflexes
Laboratory data
Serum cortisol, 1 μg/dl (normal 8:00 AM, 9–12 μg/dl)
ACTH, 310 pg/ml (normal 8:00 AM, 30–120 pg/ml)
Questions
1) What two principal hormone deficiencies are present?
2) What symptoms reflect each of these deficiencies?

Adapted from Hershman (4).

tion test and the dexamethasone test of negative feedback, including why the result reflects the likely absence of a pituitary tumor. Moreover, they can use information from the first lecture to discuss whether the patient's problem is primary, secondary, or tertiary in origin. Finally, the changes in pigmentation attributable to elevated ACTH reemphasize the relationships of this molecule to melanocyte-stimulating hormone.

An expanded version of this patient problem (Table 5) is presented at a later date in the lecture ''Adrenal Cortex: Glucocorticoids.'' In this lecture, the case is used to emphasize differences attributable to the effects of reduced levels of glucocorticoids versus mineralocorticoids (covered previously in the renal block).

DISCUSSION

There are many sources of possible clinical scenarios for these lectures. Because searching the original literature is very time consuming, I have focused on published collections of case studies, such as Refs. 1, 4, and 8. Other rich sources include collections of original cases from clinical colleagues.

The response to this teaching motif has been very positive. The students in the classroom respond well to the challenge of answering the questions posed during the after-lecture discussion. Moreover, the students' verbal feedback has been enthusiastic. Formal evaluations of the medical physiology course at Tulane are done principally by an elected student organization and are usually presented as a synopsis to the department several months after the course concludes. In general, comments similar to ''problem solving needs to be emphasized more'' are frequently included. Before the approach of incorporating patient problems into the endocrine lecture series was developed, the student ratings of the teaching in this block averaged B (good). Since the addition of the clinical scenarios into these lectures, the rating of the endocrine block has improved to the range of B+ to excellent, including specific comments that the students ''... liked relating material clinically....'' Finally, based on the strength of the verbal and written feedback on this approach to the endocrine block, similar clinical scenarios have now been added to all lectures in the medical physiology course.

In conclusion, the interest and active participation of first-year medical students in traditional endocrine physiology lecture sessions can be greatly improved by building case-stimulated learning problems into the lectures to illustrate basic concepts covered in the lectures. An additional advantage to the use of this more active learning motif is the ability to provide continuity across a lecture block by presenting the same case in multiple sessions of the lecture block.

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Finally, this simple approach is adaptable to all medical physiology topics and to other basic science lectures as well.

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