

Teaching of Clinical Physiology in the Medical Curriculum. The Omani Model

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تدريس وظائف الأعضاء الإكلينيكية في الطب ، نموذج من سلطنة عُمان

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خلاصة : في الوقت الحاضر تبتعد مادة وظائف الأعضاء بعيداً عن دراسة وفهم وظائف جسم الإنسان ككل ، وتتجه نحو دراسة وظائف الخلايا والجزئيات . وقد أدى هذا إلى زيادة عدد الباحثين في مجال الخلايا والجزئيات وابتعاد الأطباء المتخصصين عن مجال وظائف الأعضاء . أصبح هذا التغيير له تأثير واضح على تدريس هذه المادة إذ تحول تدريسها من أقسام وظائف الأعضاء إلى الأقسام الإكلينيكية كل حسب حاجته . ويهدف هذا البحث أيضاً لإيضاح أن تدريس مادة وظائف الأعضاء في كليات الطب والمستشفيات التعليمية بالطريقة المتبعة في تجربة عُمان يمكن أن يعيد لها مكانتها في الطب كمادة قائمة بذاتها .

ABSTRACT: In recent years, Physiology, as a medical discipline is continuously drifting away from the study of the complex, integrated whole body functions towards cellular and molecular levels. This has resulted in a steady increase in molecular biologists and a steady decline in medical physiologists in departments of Physiology in medical schools. Such change is already having its impact on the teaching of body systems and integrative Physiology to medical students, as evident the shifting of such teaching from Physiology departments to the respective clinical departments where Physiology is being taught by physicians of the respective clinical departments where Physiology is being taught by physicians of the respective clinical disciplines. The aim of this presentation is to show that the introduction of the teaching of Physiology in medical schools and teaching hospitals can help to restore the integrity of medical Physiology as an entity in medicine.

Research activities in Physiology are currently very much directed to the cellular and molecular levels. This development, which is logical and natural, does however pose some problems for Physiology as an important component of the preclinical curriculum in medical schools (Giebisch et al., 1990).

Research using the new techniques in cellular and molecular studies consumes a considerable part of the available research funds and tends to attract basic scientists rather than medical graduates. These newer generations of physiologists are likely to become more and more alienated from the study of the complex, integrated functions of human beings and from the teaching of Physiology to medical students.

In response to this development some medical schools resorted to highly specialized in organ system based courses to take over the teaching of Physiology.

This may provide excellent links between Molecular or Cellular Physiology and Cardiology or Neurology etc. but it does not help the students develop the all important understanding of how the human being functions as a whole.

These highly specialized clinicians, many of whom have little training in basic Physiology, also set up investigative methods originally developed in Physiology

laboratories. This type of organization is usually best suited to serve Departments of Cardiology or Pneumonology etc., but it decreases the important feedback to Physiologists, and may lead to unnecessary and costly duplication of medical services.

Clinical Physiology as developed in Scandinavia and particularly in Sweden, provides an interesting alternative development of Physiology (Linderholm, 1990).

The International Union of Physiological Sciences (IUPS) has recognized Clinical Physiology as a separate branch of Physiology by approving a Commission of Clinical Physiology so as to promote the development of Clinical Physiology internationally. There exists a Scandinavian Society of Clinical Physiology with its own international journal, "Clinical Physiology." The Society arranges regular congresses and the latest Scandinavian Congress of Clinical Physiology took place in 1997. The first International Congress of Clinical Physiology was held in Stockholm in September, 1995.

The Omani model of Physiology is to expose students in basic medical sciences to clinical problems early in their system courses and to continue the teaching and applications of physiological methods in patients' care in the Clinical Physiology Department at the University Hospital, as well as the participation of the department in

problem based learning and medical research throughout the clinical years.

Objectives of the Physiology programme

1. **In the preclinical years :**
 - a To introduce clinical problems early in the programme, emphasizing aspects of Physiology which are clinically most relevant.
 - b To develop a course in applied and Clinical Physiology which emphasizes the integrative functions of the human body. This is given at the end of the preclinical curriculum.
2. **In the clinical years :**
 - a To set up and introduce methods of investigation which originated in Physiology laboratories.
 - b To train and supervise medical students and junior doctors in the use of these methods and in the interpretation of the results.
 - c To provide basic science background for recent developments in medical practice.
3. **Clinical Service:** To provide a cost effective clinical service of Physiological tests open to all clinical specialties with proper basic science support and feed-back.
4. **Research:** To initiate, coordinate and execute research projects in clinical and basic medical sciences.

Departmental set-up and duties

The academic staff in the department of Physiology at Sultan Qaboos University consists of four medical and two non-medical with doctorate degrees. The technical staff is headed by a superintendent with considerable experience in Clinical Physiology. Each technician has one primary specialty such as Echocardiography, Electroencephalography, Polysomnography etc., but all technicians are trained to perform other simple tests such as Electrocardiography and simple Spirometry.

The Department of Physiology planned and established a central Clinical Physiology laboratory in the University Hospital the units of which are summarized in Table 1. TEE, Trans-esophageal echocardiography; CPAP, continuous positive airway pressure; G.I, gastrointestinal; EEG, Electroencephalography; EMG, Electromyography; ENG, Electroneurography.

TABLE 1

Summary of the investigations performed in the different units of Clinical Physiology and designations of the staff supervising them

Unit	Investigations	Supervisors
Cardiovascular	Echocardiography & TEE	Cardiologists
	Cardiac Catheterization	Cardiologists
	Holter Monitoring	Cardiologists
	Ambulatory Blood Pressure Monitoring	Physiologists
	Cardiopulmonary Stress Testing	Physiologists & House Officers
	Peripheral Vascular Doppler	Physicians & Surgeons
	Pulmonary Function	Physiologists & Chest Physician
Nervous System	Sleep Studies, CPAP	Physiologists, Chest Physician & ENT Surgeons
	G I Motility & pH Monitoring	Physiologists & Paediatricians
	EEG, EMG, ENG Evoked Responses	Neurologists & Physiologists

Equipment was purchased after consultations with clinicians concerned. The administration of laboratory is supervised by the Medical Physiologist in close cooperation with the Cardiologists, Pediatric Chest Physicians and Neurologists.

During the first clinical year (5th year) the Clinical Physiology staff share with other Clinical staff teaching of Problem based Learning in Cardiology, Cardiology, Medicine and Endocrinology. This course also provides practical training on Echocardiography, Electrocardiography and Pulmonary Function. In the final 7th year the students have a one week rotation in the laboratory of Clinical Physiology which is primarily intended to give them a good review of the effective and practice of physiological methods in clinical medicine.

Results

ACADEMIC WORK: The organization described keeps the Department of Physiology in close daily contact with clinical medicine. As a result, the role of Physiological methods in clinical medicine can be demonstrated to medical students at an early stage and suitable clinical cases can easily be selected for presentation to students.

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during the preclinical teaching of Physiology. This has facilitated the development of a course in Applied and Clinical Physiology which covers the common clinical problems such as heart failure, hypertension, shock, oedema, coma, cardiopulmonary adjustments in exercise and disease, fever, heat illness and jaundice etc. This course is offered at the end of the preclinical curriculum and provides the basis for the final viva examination in Physiology with participation of an External Examiner. As a result of their clinical contacts the Physiologists are requested to participate in various clinical courses, grand rounds and conferences including the weekly Clinical Pathological Conferences. The contact with the mature students in the final clinical year permits a very valuable feed-back to the teachers in the Department of Physiology.

CLINICAL SERVICE: In our setup the central service provided by the laboratory of Clinical Physiology is open to all departments in the University Hospital and also accepts referrals from other hospitals and health centres all over Oman. Utilizing the expertise of the existing Clinical and Physiology staff, rather than recruiting full-time staff, makes this set-up a cost effective and a unique Omani model.

RESEARCH: The close contact between Clinicians and Physiologists and the availability technical resources has stimulated the development of several research projects in all the disciplines shown in table 1. Projects on the prevalence of hypertension in Oman (Hassan, Abdelbasit and Lindel, 1992) variability of blood pressure in diabetes (Hassan, Al-Shafie and Johnston, 1993) and physical fitness in Omani children (Hassan and Al-Kharusi, 1994) have already been completed and published. Other projects on normal values and racial differences in pulmonary function (Strachan et al., 1997), Left ventricular mass index in obese patients with obstructive sleep apnoea (Al-Riyami et al., 1998) and diastolic function in Thalassemia Major are completed.

Discussion

In the United States integrative physiology used to have a 90-95% share of the total research support in Physiology in 1982-86. In 1991, among the five top recipients, this share had diminished to an average of 70% of the total and was down to about 30% in one prominent institution (Pinter and Pinter, 1993). If this trend continues, departments of Physiology will end up teaching fragmentary details and slowly ignoring the integrated whole. However the revolution in molecular biology now presents physiologists with unprecedented opportunities to place its central theme of homeostasis on firm molecular footing and simultaneously to use its new

methods and approaches for further exploration of the functioning of whole body mechanisms (Neill and Benos, 1993).

The number of new physiologists who are not medically qualified is increasing while those who are medically qualified is decreasing at an alarming rate. In a recent report by the Association of Chairmen of Departments of Physiology (Association of Chairmen of Department of Physiology; ACDP, 1993) only 16% of both pre- and postdoctoral physiologists received system-approach training in their preparation for a career in physiology. It is not known what percentage of those 16% were medically qualified.

"Is physiology a dying discipline?". This is the title of an article (Pinter and Pinter, 1993) in which the authors stated that if Physiology should be dying it would not be dying from old age, exhaustion or other natural causes, it would be from incomprehension and neglect. This is because as more details emerge about the living systems, the more urgent is the demand to integrate them into a coherent picture. It stands to reason, therefore, that the future of integrative Physiology should not be put in jeopardy. This is where Clinical Physiology can support general Physiology and its spin-offs from the decline that is currently affecting integrative (or organ, or systems) Physiology in some Western countries.

Clinical physiology, in the Omani model as described here, certainly helps remedy the problems in integration and clinical applications of Physiology in the clinical years in two ways. Firstly, early exposure of students to clinical problems helps them develop their integrative and problem solving abilities. Secondly, clinical rotations provide the students with continuous education in Physiology as well as practical applications of physiological measurements in disease. Since the laboratory of Clinical Physiology is accessible to all junior and senior medical staff it provides opportunities for ideas to interact, and has therefore developed into a centre for basic and clinical research.

Clinical physiology in its academic or diagnostic forms, in our experience, is an attractive branch of medicine and has definitely succeeded in bridging the gap between the rapidly developing sophisticated diagnostic techniques and the ordinary physician, as well as fortifying the knowledge and skills of clinical and graduate students. The Omani Model of Physiology has already succeeded in attracting medically qualified Omani graduates who are competing for positions in the Department.

In many large teaching hospitals Clinical Physiology tests are often done in laboratories connected to individual clinical departments. Cardiologists have their laboratory for exercise tests, echocardiography, etc., and Chest Physicians have their laboratory for pulmonary function tests including exercise tests. Similarly, Vascular