EDUCATION SESSION

A 'BIOVIDEOGRAPH' RECORDING OF SOME RESPONSES OF THE BLOOD PRESSURE AND RESPIRATION OF THE ANAESTHETISED CAT

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Demonstrations involving the recording of blood pressure and respiration in the intact mammal are an integral part of most basic physiology and pharmacology courses for medical and paramedical science students. Videotape techniques can improve some aspects of the efficiency of teaching such material but often at the expense of student involvement. Viewers unfamiliar with the experimental situation often feel remote from the processes being described and have limited recall of the experimental results.

The development of the 'Biovideograph' enables students to participate more fully in the experiments since (provided sufficient recorders are available) each student obtains a permanent record of the results as they occur. The production demonstrated is intended as an introductory tape demonstrating how a cat is anaesthetised and prepared for experiment and showing the effects of acetylcholine, adrenaline and changes in inspired gas tension on blood pressure and respiration. In the final section the effects of carotid occlusion and vagal stimulation and section are shown. Each procedure is accompanied by a theoretical explanation of the effects observed.

DRUGS AND THE EYE: GLAUCOMA

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A tape-slide discussion which first revises the structure and innervation of the eye and the different way drugs may be administered to it. The main section on glaucoma deals with the symptoms and diagnosis of the disease as well as the use of drugs classified on a pharmacological basis.

FROG SKELETAL MUSCLE EXPERIMENTS USING A TRANSIENT STORAGE RECORDER AND BIOVIDEOGRAPH PRESENTATION

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Recent developments in instrumentation have made available recorders which in addition to displaying responses can also retain them in a memory store. One such device is the transient storage unit built into a M400 MD1 recorder (Biosciences, Sheerness, Kent). When this modified recorder is used in conjunction with a television presentation via a Biovideograph system (Biosciences) it enables complete experiments to be presented to students together with a trace of the experiment. This is even possible for preparations which respond very rapidly for example electrically stimulated frog gastrocnemius muscle preparation, which previously necessitated either a kymograph or a very sophisticated recorder to be used. Conventional recorders would usually attenuate the rapid response but the transient storage device can capture a brief response, say 100 msec in duration and reply it over a 5 sec period which eliminates the attenuation. The time scale is of course changed on the slave driven recorder but calibration marks produced by the storage device allow accurate timings of the different phases of the response to be determined.

In our scheme of practical classes, a series of programmes have been developed using the transient storage device for three major reasons. Firstly, there is no need to use large numbers of frogs to demonstrate well known properties of skeletal muscle. Secondly, the classes take less time to carry out and so a great range of experiments may be shown to students in any given time, and thirdly, there is a reduction in cost of the practical classes.

The Biovideograph tape which will be shown is the first of a series we have made illustrating to first year undergraduate students the properties of frog skeletal muscle.

MICROCOMPUTER SIMULATION OF PHARMACOKINETIC BEHAVIOUR OF DRUGS FOR TEACHING AND LEARNING

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A package of pharmacokinetic simulation programs written in Basic for the Apple II Plus and IIe microcomputers will be demonstrated. An introductory menu offers the user a choice of 4 programs of two kinds. The first kind consists of 3 programs which respectively simulate one-compartment, two-compartment and Michaelis-Menten pharmacokinetic behaviour. For each, the user must enter limits for the concentration and time axes, the kinetic parameters, the doses for the chosen routes of administration and the simulation time. The second kind (one program) simulates the kinetic behaviour of selected drugs. In this case the kinetic parameters for each drug are read from data statements within the program.

All programs make use of numerical integration and input control subroutines written by Dr R.D. Purves. They also incorporate a number of features of the NUMINT simulation programs described by Koup & Benjamin (1980). Emphasis has been placed on simplicity of use. The package is designed for teachers who wish to demonstrate pharmacokinetic phenomena and principles and for students who wish to see for themselves what happens to drugs in the body and how pharmacokinetic parameters determine pharmacokinetic behaviour.

Each simulation allows drug doses to be given singly or repeatedly by one or any combination of four routes; i.v. bolus injection or infusion, or an extravascular route requiring absorption (oral, i.m.). Concentration is plotted on either an arithmetic or logarithmic scale, the latter over any desired number of decades. The total simulated period of observation may range from minutes to days or even weeks. If the total time exceeds the chosen length of the time axis, the simulation automatically 'wraps around' the screen. Single keystroke options displayed at the end of each observation interval allow the user to continue observing the changing concentration, to repeat the dose, to change the dose and route of administration, to superimpose a new simulation starting at the origin (this is particularly useful for comparing the effects of changing parameters, doses or dose routes), or to end the simulation and go to a menu of general options.

Koup, J.R. & Benjamin, D.R. (1980) Ther. Drug Monitoring 2, 243-247

MCQs IN PLACE OF FORMAL WRITE-UPS OF DEMONSTRATIONS

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The merits of large class demonstrations in pharmacology to medical students in their preclinical years have been reported (D'Mello & Kruk 1976). Students receive handouts of methodologies used, and a sample tracing of results, and are then expected to produce a write-up which may (or may not) be used in formal assessment of the student. Such write-ups are time-consuming for both the teacher and the student, and less than full enthusiasm for the task is not an infrequent reaction.

We have been using multiple choice questions for a number of years for in-course assessments and examinations, and more recently we have been using them for teaching (D'Mello & Kruk, 1982). We have now started to substitute some demonstration write-ups by an MCQ paper. Students attend the demonstrations, receive handouts of methodologies used and a sample tracing of results, and are advised to take note of events in the conventional manner. At the end of the session they are given an MCQ paper and an answer sheet for computer marking. They have to return the answer sheet within two days, and this is then computer marked, and a performance list obtained. At this time, the students receive the correct answers to all the MCQs. The students are encouraged to research their answers from whatever sources they have available, and we have found a high rate of compliance (number of students handing in their answer sheets), and a high standard of answers (as judged by the marks obtained). Students who do not hand in answer sheets or who perform badly are easily identified, and appropriate action can be taken. This method of teaching and assessment appears popular with both students and staff.

D'Mello A & Kruk Z L (1976) Brit J Pharmac 58, 314P
D'Mello A & Kruk Z L (1982) Brit J Pharmac 77, 583P

AN ALTERNATIVE METHOD FOR PHARMACOLOGY LABORATORY CLASS INSTRUCTION USING BIOVIDEOGRAPH (R) VIDEO TAPE RECORDINGS

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The advantages of the Biovideograph instructional technique have been reported previously (Leach, 1979; Henman & Leach, 1981) and this communication describes the provision of an educational technology based Pharmacology laboratory course.

Comparison has been made of the teaching effectiveness of the videotape and laboratory instruction methods by means of short answer tests using two equal ability groups of randomly selected second year Pharmacy undergraduates of the University of Bradford. The second year Pharmacology laboratory course includes eight isolated organ experiments; one group received instruction through a Biovideograph programme of about 1 hour duration produced by the Educational Development Service of the University of Bradford, whilst the other was taught using a three hour individual student laboratory class. The extent of background knowledge possessed by students prior to class instruction was assessed by half the group undertaking a 'pre-test' of the short answer test paper.

Table 1 Mean pre- and post-test performances of two groups of students receiving laboratory instruction by either Biovideograph or individual participation

Experiment	Max. Score	Pre-test performance (mean score ± s.e.)		Post-test performance (mean score ± s.e.)	
		GROUP A	GROUP B	GROUP A	GROUP B
Agonist dose response	20	4.8±.74	4.2±.39	11.6±.53**	6.1±.49
Competitive antagonism	20	5.2±.78	7.2±.59	14.2±.52**	9.7±.28
Sites of action:Guinea-Pig ileum	22	8.3±1.12	5.9±.62	16.8±.47**	10.6±.58
Sites of action:Rabbit duodenum	15	5.6±.61	5.5±.58	11.3±.23**	8.0±.38
Cholinesterases	10	5.4±.73	5.8±.57	8.2±.27*	7.4±.26
Affinity constant	7	2.5±.42	2.6±.31	5.4±.20**	3.8±.24
Non-competitive antagonism	10	3.9±.55	3.5±.53	8.1±.21**	4.1±.35
Biological assay	16	3.3±.45	2.1±.26	9.1±.37	8.6±.49

Pre-test group size n = 12-13.
Post-test group size n = 24-26. Post-test significance *P<0.05, **P<0.001

Table 1 shows the results obtained from the tests. In the case of the first seven experiments, Group A received Biovideograph instruction and obtained significantly greater mean performance scores compared with those receiving laboratory class instruction. In the last experiment 'Biological assay', Group B received the programme and Group A was given conventional class teaching. Thus the effectiveness of the Biovideograph videotape programme as an alternative method is convincingly demonstrated. Given the assumption that the equipping of the laboratory including the Biovideograph, is part of the fixed setting up cost, the estimated cost in staff time and materials for a three hour laboratory class is £77 compared with £37 for a single replay of a Biovideograph tape.

Leach, G.D.H. (1979) Br. J. Pharmac. 67, 504P
Henman, M.C. & Leach, G.D.H. (1981) Br. J. Pharmac. 74, 312P

MICROCOMPUTER-BASED SIMULATION OF AN INTACT ANIMAL PREPARATION

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The current acceptance of microcomputers into pharmacology has greatly increased the potential for cost-effective teaching and research programmes. Simulation of simple isolated tissue experiments has already been described (French & Gilbert, 1982, Morgan, 1982) thus illustrating the potential use of microcomputers in this area of teaching. In this department simulated guinea-pig ileum, frog rectus abdominis and rat diaphragm experiments have been introduced into the practical course and the results obtained have been encouraging.

Although these simulations have in themselves proved to be cost-effective in terms of time and resources, the logical progression must be the simulation of more complex intact animal preparations. The use of whole animal preparations is desirable if the effects of drugs and their interactions on an integrated system is to be studied. Spinal cat or rat preparations are now usually limited to demonstrations because of increasing demands on available resources and in any event such preparations are short lived and, for obvious reasons, only a limited number of drugs can be studied on any one preparation.

The experimental simulation presented for this demonstration allows the user to make qualitative and quantitative assessments of the effects and interactions of a range of drugs on the cardiovascular system of an intact animal preparation. The program also mimics selective electrical stimulation of the autonomic outflow thus allowing the user to establish, by appropriate means, the principle transmitter substances involved and their respective sites of action.

The system is based on a CBM microcomputer which delivers generated data, representative of blood pressure and heart rate, via a multiplexed digital to analogue converter to a twin channel chart recorder. This output data is generated by means of the appropriate algorithm embedded in the program and is related to input data received from the keyboard. A menu of drugs and selected stimulation parameters is presented to the user on the VDU and from this the user makes his choice which is subsequently entered via the keyboard. Drug dose or stimulation frequency is similarly chosen and entered and the response calculated on the basis of this input is passed to the chart recorder and the displayed trace suitably modified. Construction of dose or frequency response curves in the absence and presence of agonists/antagonists is possible thus allowing quantitative as well as qualitative assessments of drug effect to be made. Information representing intrinsic activity and dissociation constants for agonist drugs and affinity constants for antagonists is stored in the program and, based on the users' selection, appropriate values are substituted into the algorithm. A degree of random response variation is incorporated into the program to mimic the effects of biological variation.

This model enables a rapid and economical investigation of the effects and interactions of a number of standard drugs on a whole animal preparation.

French, A.M. & Gilbert, J.C. (1982) Br. J. Pharmac. 77, 587P.
Morgan, R.M. (1982) Br. J. Pharmac. 77, 588P.

FLUID MODELS TO DEMONSTRATE SIMPLE PHARMACOKINETIC EQUATIONS

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To exemplify the relationship between clearance, Cl, apparent volume of distribution, Vd, and elimination rate constant, k_{el} :

$$Cl = Vd.k_{el}$$

a simple model was produced. Water was pumped at a constant rate, Q, into a Buchner flask and the overflow from the side-arm led to waste. The contents of the flask were kept well stirred and a known quantity of sodium salicylate introduced. Samples (1 ml) were removed at suitable intervals for assay with ferric nitrate. Students use the data to calculate : $t_{\frac{1}{2}}$; k_{el}; C_o; Vd and Cl. No salicylate is returned to the flask so this is equivalent to an extraction ratio, E, of 1 and the Cl equals the flow rate :

$$Cl = Q.E.$$

The calculated Cl and Vd values can be compared with the measured flow and volume.

Further refinements include using dyes, coupling the outflow to a spectrometer for continuous measurement of concentration, etc. Coupling two flasks in series allows first order input into the second to demonstrate oral dosing. Infusions, multiple dosing, etc., can be demonstrated.