K^+-induced relaxations of the rat anococcygeus muscle

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The actions of potassium chloride (KCl) on the rat anococcygeus muscle are complex (Gibson & Pollock, 1973). On the resting muscle, KCl produces dose-dependent contractions, which are partly due to release of endogenous noradrenaline (NA) and partly to a direct depolarisation of the muscle membrane. However, when the tone of the muscle is raised, by acetylcholine (ACh) or guanethidine, KCl now produces dose-dependent relaxations.

Two possibilities might explain these relaxations produced by KCl. Firstly, since KCl caused the release of motor transmitter (NA) it was possible that the relaxations were due to release of the as yet unknown inhibitory transmitter thought to exist in this tissue (Gillespie, 1972). Alternatively, it has been suggested that KCl might inhibit muscular activity by stimulating Na/K ATPase activity on the muscle membrane (Johns & Paton, 1974; Shibata, Fukada & Kurahashi, 1973) thus producing hyperpolarization and consequently relaxation. The purpose of the present study, therefore, was to determine which, if either, of the above mechanisms might explain KCl-induced relaxation of the rat anococcygeus muscle.

Adult male Wistar rats were killed by stunning and exsanguination. The two anococcygeus muscles were dissected (Gillespie, 1972) and suspended in oxygenated Krebs bicarbonate solution (36°C). To observe muscle relaxations to KCl the tone was first raised by addition of ACh (40 μM), normally in the presence of phentolamine (1 μM).

As found previously, KCl produced dose-related relaxations of the contracted anococcygeus muscle. Other K^+ salts (bicarbonate and tartrate) also relaxed the muscle, while NaCl was ineffective suggesting that the active ion was K^+. Dose-response curves for the contractile and relaxant actions of KCl were obtained, and these suggested that the muscle was more sensitive to the relaxant effects of KCl.

The K^+-induced relaxations were unaffected by addition of ouabain to the bathing medium (100 μM for 30 min). However, the relaxations were completely, but reversibly, abolished by tetrodotoxin (5 μg/ml). The local anaesthetics procaine or cocaine (both 500 μg/ml) also abolished K^+-induced relaxations, although they did not abolish the response to ACh, nor the relaxation following washout of agonist. Cooling the muscle to 10°C had a similar effect to that of the local anaesthetics.

In conclusion these experiments suggest that K^+-induced relaxations of the rat anococcygeus muscle are not due to stimulation of muscle Na/K ATPase, but that they are neurally-mediated and are probably due to release of the unknown inhibitory transmitter, the inhibitory nerves being more sensitive to the actions of K^+ than the motor nerves.

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How can one set multiple choice examinations of equal difficulty from year to year?

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The method which I am exploring attempts to predict the outcome of an examination as a normally distributed relationship between proportion of the candidates and score in the examination. The scoring system used is: correct +1, incorrect −1/(A-1), no answer 0. The mean score and variance of scores are obtained as in Figure 1.

The method used predictively makes three assumptions

(1) that P_i can be estimated from the scores on question i attained by previous classes of candidates (and similarly Q_i and $1-P_i-Q_i$).

$$\text{MEAN SCORE} = \sum_{i=1}^{N} P_i - \frac{Q_i}{A_i - 1}$$

$$\text{VARIANCE} = \text{VAR}_I Y + 2 \sum_{i=1}^{N} \sum_{i \neq j}^{N} R_{ij} \sqrt{\text{VARX}_i \times \text{VARX}_j}$$

$$\text{where } \text{VAR}_I Y = \sum_{i=1}^{N} \text{VARX}_i = \sum_{i=1}^{N} P_i (1-P_i) + \frac{2P_i Q_i}{A_i - 1} + \frac{Q_i(1-Q_i)}{(A_i-1)^2}$$

where i or j = question number
N = total number of questions
P = probability of occurrence of correct answer
Q = probability of occurrence of incorrect answer
A = number of answer options
R = correlation coefficient

Figure 1

(2) that R_{ij} can be estimated from an average of the correlation coefficients between the scores on every question and those on every other question obtained in previous examinations.
(3) that the distribution of candidates' scores on the whole examination can be estimated by a normal distribution. The current tests of the validity of these assumptions will be presented together with examples of comparisons between predicted and attained distributions.

Standardization from year to year would involve substitution of certain questions in the proposed examination until a prediction indicating the required difficulty emerged.

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Comparisons of performance in pharmacology examinations using multiple choice and essay questions

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Multiple choice questions (MCQ) have established a place alongside traditional essay questions in examinations in preclinical and clinical medicine. Ideally, the MCQ examination should be used to complement rather than to replace essay question papers, since the use of both types of examination explores a wider range of qualities of the candidates than if a single examining technique is used. Thus, a fairer and more comprehensive evaluation of the candidates may be made.

The automated marking and assessment methods used in our MCQ examinations have been demonstrated previously to the Society (Hoult, 1974) and the data presented here concern the results of six pharmacology examinations taken by preclinical medical students. Each examination comprises essay and MCQ sections. The essays are marked on a 'close-marking' scale (pass mark = 50) and the MCQ scores are adjusted to give a pass mark of 50. Individual candidate scores and the results of the whole group for the MCQ and essay sections have been compared to see if the two types of examination provide similar information about the abilities of the candidate.

The twelve frequency histograms of the scores of