A simple precise method for measuring rodent paw volume

Rodent paw oedema is the basis of a multitude of acute and subacute test procedures for the evaluation of anti-inflammatory agents. Several methods for the determination of paw volume have been described, many being based on the method of van Arman cited by Winter, Risley & Nuss (1962). These rely on the vertical displacement by the paw, of a pool of mercury. This, in turn, is estimated by pressure change or the alteration in electrical resistance of a graphite rod inserted in the mercury. These methods were found to be unsatisfactory in our hands. The main problem was lack of sensitivity. This could only be overcome by reducing the diameter of the mercury vessel thus making more difficult the actual measurement of paw volume. This problem was particularly acute in the case of rats suffering from adjuvant disease with its consequent joint immobilization where accurate alignment of the limb proved difficult. A second problem was one of reproducibility. This was due to difficulties with the high degree of amplification required when a pressure system was used, or to coating of the graphite rod when a resistance method was used. Rather than embark on a program of development of one of these systems, we developed a method based on Archimedes principle.

A bath of mercury (a 50 ml beaker containing approximately 35 ml) was mounted on a one decimal top loading tare balance (Mettler P1210). In operation, the increase in weight registered on the balance was noted after insertion of the animal's paw into the mercury. It was possible to tare rapidly between readings when necessary and the relatively large surface area of mercury provided ease of access and accurate alignment of the paw.

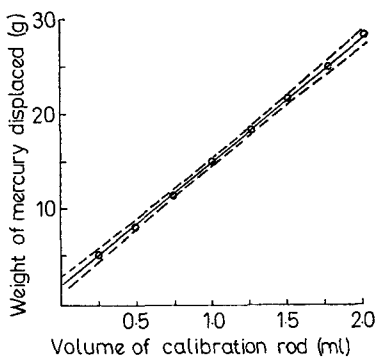

FIG. 1. Calibration line showing the calculated regression (Corr. Coeff. 0·998, slope 13·1). The curves above and below the regression line show 99% confidence limits. Each point was the mean of 4 readings taken blind, using a Perspex rod (8 mm diam. calibrated at 5 mm intervals). The intercept is 1·96 g. This represents the force exerted by the calibration rod whilst distorting the mercury meniscus.

A regression line showing the weight of mercury displaced by the insertion of a known volume is shown in Fig. 1. The volume/weight displaced relation was shown to be precise (correlation coefficient 0·998) and linear. 99% confidence intervals for apparent volumes of 0·5 ml and 2·0 ml were 0·06 ml and 0·08 ml respectively.

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January 30, 1975

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