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Measurement of body temperature in conscious small laboratory animals by means of an oesophageal thermocouple

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A device is described for making rapid repeated measurements of body temperature in conscious small laboratory animals. A thermocouple, sealed inside an 18 gauge hypodermic needle is inserted into the oesophagus and the temperature read directly on a calibrated meter.

THE effects of a drug on body temperature, or the modification by a drug of a temperature change induced by a second drug or by other means, affords a suitable way of indicating certain types of pharmacological activity in laboratory animals. Sympathomimetic drugs are capable of invoking a hyperthermic response by an action on central adrenergic receptors (von Euler, 1961). Lessin & Parkes (1957) have shown that in mice the hypothermic effects of chlorpromazine and reserpine are related to their sedative properties. Morphine induces a biphasic temperature response in rats comprising an initial fall followed by a rise of temperature (Gunne, 1960) and Chodera (1963) has used this effect to investigate the interaction of morphine with monoamine oxidase inhibitors. In most experiments of this nature the body temperature of small laboratory animals is measured using a thermometer, thermocouple or a thermistor inserted in the rectum; in a few experiments skin thermocouples have been used. Measurement of body temperature using a skin thermocouple suffers from the disadvantage that local changes in blood flow inevitably affect local skin temperature without affecting the true body temperature. The methods using the rectal route necessitate substantial immobilisation of the animal and thus impose much stress which may in turn exert a decisive effect on the temperature recorded. In addition, it has been our experience that the use of rectal thermocouples in mice, rats and guinea-pigs by a single operator is a relatively slow process and frequent repeated measurements of body temperature are difficult with large numbers of animals.

It was decided that an alternative method to those in current use was necessary to measure body temperature in small laboratory animals. Accordingly a small thermocouple was sealed inside a bent 18 gauge hypodermic needle, 4·5 cm long (Fig. 1). The bend makes it easier to insert the thermocouple into the oesophagus of mice, rats or guinea-pigs, which are held as for oral administration of drugs. The oesophageal thermocouple was specifically designed for use with a commercially available electric thermometer*. The thermocouple is connected to the electric thermometer which contains a thermocouple amplifier and its power supply. The amplifier is fully transistorised and is of the chopper

From Research Division, Allen & Hanburys Limited, Ware, Hertfordshire.

* Electric thermometer Model BA 9000, Allen & Hanburys (Surgical Engineering Division) Limited, Bethnal Green, London, E.2.

type, the chopper being run at mains frequency. There is feedback over the amplifier which linearises it, stabilises its gain and gives a high imput impedance, so reducing the effect of thermocouple resistance on the calibration. The output is displayed on a calibrated 0·1 mA meter, the recorded temperature being read directly in degrees centigrade. Over a wide range (5 to 40°) of laboratory temperatures and recorded body temperatures the accuracy of the instrument is within ±0·2°. In particular, for a laboratory temperature of 20° and a recorded body temperature of 37° the accuracy is within ±0·1°.

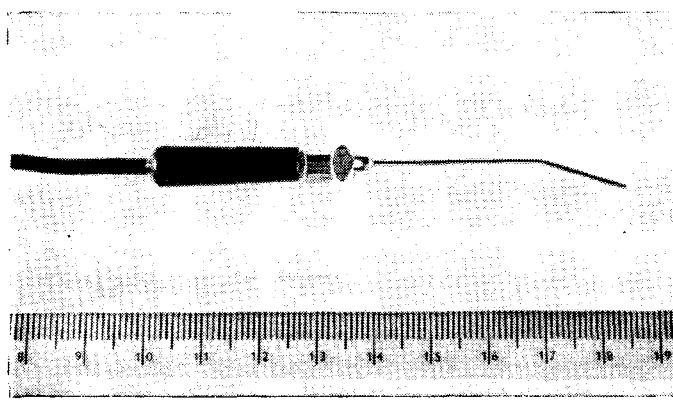

FIG. 1. The oesophageal thermocouple. (Each small division of the scale is 1 mm).

The measurement of body temperature in small laboratory animals by this method is a rapid, simple and acccurate procedure. Following insertion of the thermocouple in the oesophagus a constant temperature reading is obtained in 3 to 4 sec. In a total time of approximately 8 sec, a single operator can remove a mouse from its cage, measure and record its oesophageal temperature, and replace the animal in the cage. The body temperature of 10 mice can be individually measured and recorded in less than 90 sec.

The use of this oesophageal thermocouple is illustrated in the following experiment. Reserpine induces marked sedation in mice and rats characterised by ptosis, locomotor inactivity and hypothermia. The severity of the depression may be assessed by visual methods and the antagonism of reserpine-induced depression has been used to detect possible antidepressant activity in test compounds (Sulser, Watts & Brodie, 1962; Wilson & Tislow, 1962). However, visual assessment of the degree of sedation is liable to subjective error and quantitative comparison of active compounds is difficult. In our experience antagonism of the depressant effects of reserpine, for example with imipramine, amphetamine, monoamine oxidase inhibitors and other drugs, is always accompanied by either a rise in temperature (if established depression is being reversed) or prevention of a fall in temperature (if depression is being prevented). Since temperatures could now be measured quickly and accurately, a new quantitative method was available for comparing the activities of compounds found to have anti-reserpine activity. As an example, some results are given for the effects of amphetamine in established reserpine depression. Ten male white (Tuck) mice, weighing 18 to 22 g, each received an intravenous injection of reserpine, 1 mg/kg; 4 hr later, 5 animals were given amphetamine, 15 mg/kg, orally. The remaining 5 animals received distilled water orally and served as reserpine controls. The anti-reserpine effect of amphetamine is clearly demonstrated by its action on reserpine-induced hyopthermia (Fig. 2).

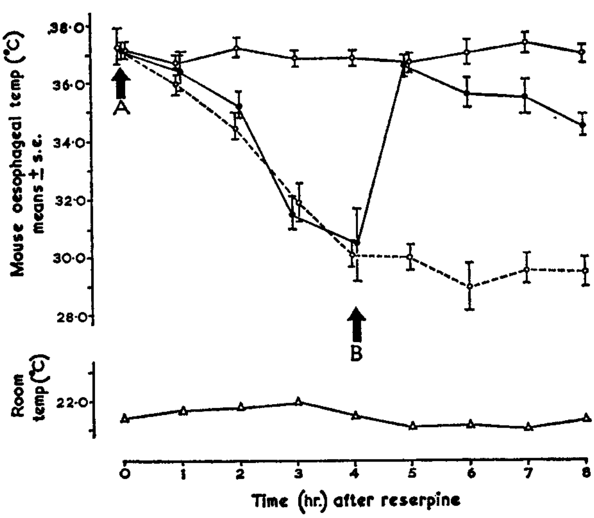

FIG. 2. Effect of amphetamine on the body temperature of reserpine-treated mice. ○—○ Untreated mice. ○----○ At A, reserpine 1 mg/kg. i.v. ●—● At A, reserpine 1 mg./kg. i.v., at B, amphetamine 15 mg/kg orally. △—△ Laboratory temperature.

It is obvious that other quantitative applications will be found for this apparatus because of the possibility of a single operator measuring the body temperatures of large numbers of small laboratory animals accurately, quickly and if desired at frequent time intervals without unduly disturbing the animals.

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