A PIEZOELECTRIC METHOD OF RECORDING PULSE AND PRESSURE IN THE CAUDAL ARTERY OF RATS

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A graphic method of recording the pulse and systolic pressure in the caudal artery of rats in long-term experiments is described. The method is bloodless and no heating of the tail is required. The pulse is detected by a piezoelectric transducer. The standard detector of a mark TEM-15 telemanometer, modified to produce a discrete signal, is used as the manometer. The pulse rate in rats was found to be 360 ± 12 beats/min and the systolic pressure 121 ± 2.6 mm Hg.

To measure the systolic arterial pressure in long-term experiments most workers use some type of plethysmographic method, although this does not permit the pulse rate to be studied or the pressure to be recorded graphically [1, 2, 8, 12, 13, 16, 17]. There is no adequate description in the literature of an apparatus capable of recording the pulse rate and blood pressure of rats graphically, although the design of a piezoelectric transducer [3, 4] and an electromanometer [5] has been described.

The authors have made certain modifications to the design of the piezoelectric transducer described elsewhere [1, 3]. The piezocrystal in the transducer built by the authors is located not on the convex side of the plate, but on the concave side (Fig. 1), thus increasing its sensitivity. To record the pressure in the cuff, unlike in the previous investigations a standard detector of a type TEM-15 telemanometer is used.

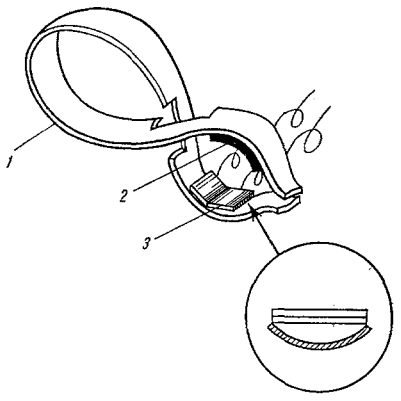

Fig. 1. Piezoelectric transducer: 1) brass clip; 2) rubber lining; 3) piezocrystal.

To obtain a discrete output signal the winding of the potentiometer of the detector is modified so that a single pulse is obtained for a change in pressure of 6-10 mm Hg. The metal membrane is also replaced by a rubber lining to increase sensitivity. After modification, the manometer emitted 35-40 pulses during a change in pressure from 0 to 200 mm Hg.

Pulse waves and electromanometer signals were recorded on two channels of a four-channel Orion (Hungary) electroencephalograph (of the ÉÉG-01 type); the rat was kept in a screened chamber during the investigation.

By using a highly sensitive electroencephalograph as recording instrument, it is unnecessary to warm the rats' tail, as is recommended in most other methods described previously [2, 3, 8, 9, 15, 16], thus simplifying the procedure considerably.

The apparatus consists of a compression cuff in the form of a brass cylinder 8-12 mm in diameter and 10-15 mm long, with slightly upturned edges and a hole with a tube in the middle, inside

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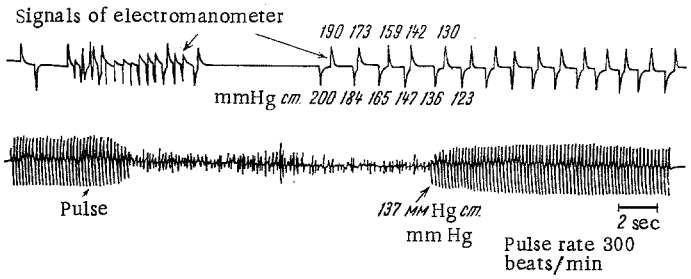

Fig. 2. Record of the pulse and blood pressure of a normal rat.

which is stretched a rubber membrane, fixed with threads on either side. The compression cuff is connected to a sphygmomanometer and electromanometer through a vessel with capacity 0.5 liter. The piezoelectric transducer rests with the working surface of the crystal against the lower surface of the tail beyond the compression cuff. By this means a clear record of the pulse is usually obtained at once (Fig. 2).

Recordings can be made on unanesthetized animals provided that they are allowed to become gradually accustomed to the procedure. It is much more convenient to do the recording under superficial ether anesthesia, as many investigators have shown this does not affect the results of the measurements [9, 10, 13-15].

The electromanometer is calibrated from readings of a sphygmomanometer. The pressure in the cuff is lowered from a value known to be above the systolic pressure, e.g., from 200 mm Hg. The systolic pressure level in the caudal artery corresponds to time of appearance of pulsation in it distally to the compression cuff (Fig. 2).

The following results (M ± m) were obtained by measuring the pulse rate and arterial pressure in 80 normal rats by means of this instrument: pulse 359 ± 12 beats/min, systolic arterial pressure 121 ± 2.6 mm. The limits of variation of the pulse rate were 420-260/min (on the same day, the heart rate of one rat varied by 5-20 beats/min, and on different days by 60-95 beats/min). The limits of variation of the systolic pressure were 82-145 mm (on the same day by 5-12 mm, on different days by 10-20 mm). The values obtained are close to those in the literature [2, 3, 9-12].

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