A METHOD OF POLAROCOCHLEOGRAPHY AND MEASUREMENT OF THE PERILYMPH PRESSURE IN THE INNER EAR IN ACUTE EXPERIMENTS ON ANIMALS

V. A. Romanov

UDC 612.858-087.5

The bulla was opened in anesthetized dogs, cats, and guinea pigs and a copper amalgam electrode inserted into the fenestra rotunda, the second electrode (made of carbon steel) being introduced into the lingual muscles. The previously amalgamated electrode was introduced into the capillary tube of a Panchenko's apparatus. The capillary tube was fixed firmly into the fenestra rotunda. The amalgamated electrode was lowered down the capillary tube, and passed through the secondary tympanic membrane into the scala tympani. A column of perilymph rose up the capillary tube and showed the pressure in the cochlea. The level of the pressure was noted visually and measured in mm water. The electrodes were connected to the pace of an electrode pair, which was itself connected to an oxyhemograph on which the changes in oxygen pressure in the perilymph were recorded.

The polarographic method of investigating the oxygen tension in the tissues has been used [5] in acute experiments on guinea pigs to determine the oxygen pressure in the perilymph of the cochlea. Platinum and silver electrodes were inserted into the scala vestibular and scala tympani of the basal coil of the cochlea. The oxygen tension in the perilymph was recorded by means of a complicated apparatus [3, 4] and the procedure inflicted considerable trauma on the inner ear, the fenestra rotunda and fenestra ovalis, the scala tympani, and scala vestibuli, and thus prevented measurement of the perilymph pressure in the cochlea.

The authors have developed a less traumatic and simpler method of polarocochleography allowing simultaneous recording of the perilymph pressure in the cochlea.

Acute experiments were carried out on anesthetized animals (15 dogs, 68 cats, and 8 guinea pigs). A cannula was inserted into the animals' trachea and connected to an artificial respiration apparatus [2]. A cannula for injection of drugs was introduced into a subcutaneous vein of the neck. Through a ventral incision the bulla ossea was opened to provide good exposure of the fenestra rotunda, where a special electrode was introduced. An amalgam (active) electrode was prepared before the experiment from copper wire 0.2-0.3 mm in diameter, covered with insulating varnish. The varnish was removed from one end of the wire for a distance of 1.5 mm, and the tip was sharpened to a cone, polished, and then amalgamated. The varnish was removed from the opposite end of the copper wire, which was connected to the base of an electrode pair, which was then plugged into the socket of an oxyhemograph pick-up [1]. The second electrode (anode), made from carbon steel, also was connected to the base of the electrode pair. The previously amalgamated electrode was introduced into a graduated glass capillary tube from a Panchenko's apparatus. The distal end of the capillary tube was pointed so that it could be inserted firmly into the fenestra rotunda. The glass capillary tube was fixed to the stand of a microscope, so that it could be introduced into the fenestra rotunda and fixed there. The amalgamated copper electrode was then lowered down the capillary tube through the

Department of Diseases of the Ear, Throat, and Nose, Semipalatinsk Medical Institute. (Presented by Academician of the Academy of Medical Sciences of the USSR A. M. Chernukh.) Translated from Byulleten' Éksperimental'noi Biologii i Meditsiny, Vol. 75, No. 1, pp. 89-91, January, 1973. Original article submitted August 19, 1971.

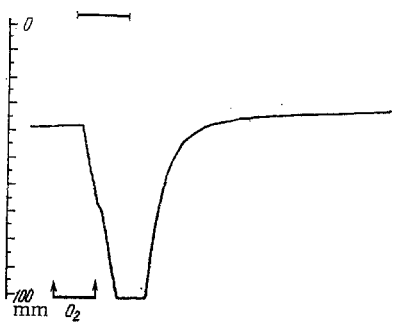

Fig. 1

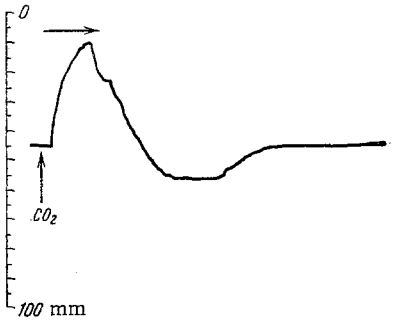

Fig. 2

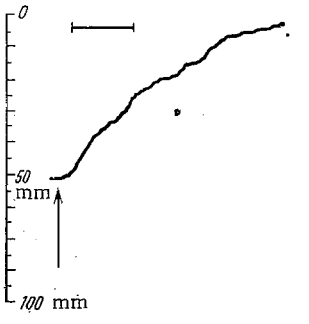

Fig. 3

Fig. 1. Character of change in oxygen saturation of perilymph in dogs during inhalation of pure oxygen for 1.5 min.

Fig. 2. Change in oxygen saturation of perilymph in guinea pigs during inhalation of carbon dioxide.

Fig. 3. Effect of asphyxia in cats on oxygen saturation of perilymph. Vertical arrow indicates time of stopping respiration.

secondary tympanic membrane into the perilymphatic space of the scale tympani of the basal coil of the cochlea to a depth of 1.5-2 mm. After fixation of the electrode the bulla was filled in some experiments with melted wax. This ensured airtight closure at the junction between the glass capillary tubes and fenestra rotunda of the inner ear. The second electrode was inserted into the lingual muscles. After performation of the secondary tympanic membrane a column of perilymph rose up the capillary tube and showed the pressure inside the cochlea. The level of the pressure was noted visually and measured in mm water.

The oxyhemograph together with the pick-up were warmed for 30-40 min. The calibration system of the instrument was checked with the aid of filters. The scale switch was set in the 100-60% position. The pick-up was then replaced by the base of the electrode pair. Stable readings of the oxyhemograph were obtained after 20-30 min.

To verify the sensitivity and objectivity of the method, the oxygen tension in the perilymph and the pressure of the perilymph in the cochlea were measured in acute experiments on animals during inhalation of pure oxygen and carbon dioxide, during asphyxia, and after administration of various drugs. Inhalation of oxygen for 2 min by dogs was accompanied by elevation of the polarocochleogram on the average by 60%. After the inhalation of oxygen ceased it returned to its initial level and then fell by a further 2-3% (Fig. 1). In guinea pigs on the inhalation of carbon dioxide the partial oxygen pressure in the perilymph fell initially by 35%, then rose by 12%; after 7 min it returned to its initial values (Fig. 2).

Complete cessation of respiration in cats for 7 min led to a gradual decrease in the oxygen tension in the perilymph by 50% (Fig. 3).

The initial level of pressure in the perilymph in the cochlea was 30± 2.2 mm water. During inhalation of oxygen the pressure of the perilymph increased on the average by 5 mm water.

LITERATURE CITED

1. A. I. Beketov and D. I. Sapegin, Lab. Delo, No. 4, 243 (1966).
2. V. A. Romanov, Byull. Éksperim. Biol. i Med., No. 5, 125 (1970).
3. E. Miriszlai and A. Tigyi, Kiserl. Orvostud., 17, 160 (1965).
4. P. Mounier-Kuhn, J. P. Haguenauer, and P. J. Bernard, J. Franc. Oto-rhino-laryng., 18, 209 (1969).
5. M. Tsunoo and H. B. Perlman, Acta Oto-laryng. (Stockholm), 59, 437 (1965).