

DISTURBANCE OF THE CHARACTER OF THE RESPIRATORY MOVEMENTS IN CHILDREN WITH BRAIN TUMORS AND THEIR NORMALIZATION BY ARTIFICIAL VENTILATION

N. F. Nikolaeva

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At the present time artificial ventilation of the lungs and muscle relaxants are widely used in anesthesiology. However, the influence of artificial ventilation on the respiratory curves in patients with disturbances of the character of the respiratory movements is not absolutely clear.

The object of the present investigation was to study the influence of artificial ventilation on the respiratory curves against the background of general anesthesia.

EXPERIMENTAL METHOD

The shape of the respiratory curves was studied in 167 children with brain tumors (120 with a tumor in the posterior cranial fossa and 47 with a supratentorial tumor) aged from 1 to 16 years, before operation, throughout the course of the operation, and immediately after extubation. An ink-recording pneumograph was used. One pick-up was placed along the anterior axillary line at the nipple level, the other in the epigastric region. In this way the thoracic (on one side) and abdominal respiration could be recorded. During the operation the patients were in the lateral position. The operations on all patients were performed under combined endotracheal anesthesia, using various anesthetics (nitrous oxide, ether, trilene, chloroform, fluothane, barbiturates). Artificial ventilation by means of the bag of the anesthetic apparatus was applied for 10-30 min only after intubation (in three children for 90 min). During the rest of the operation the patient breathed spontaneously.

EXPERIMENTAL RESULTS AND DISCUSSION

In 117 children the respiratory curve before the operation was regular in shape and of good amplitude, or its changes were associated with the child's age. After artificial ventilation (when the patient was being transferred to spontaneous respiration) no significant changes took place in the curve. In 50 patients (43 with a tumor of the posterior cranial fossa and 7 with a supratentorial tumor) with the most severe hypertensive and brain-stem symptoms before the operation, obvious changes were observed in the rhythm, amplitude, and shape of the respiratory curves in the form of periodic respiration of the Biot and Cheyne-Stokes type, apneusis with breath holding in expiration, respiration of gasping type with a short inspiration and rapid expiration, of irregular rhythm and amplitude (Fig. 1). After artificial respiration the normal respiratory curve was restored in all except three children (Fig. 2), and it remained rhythmic and uniform in amplitude throughout the operation and immediately after extubation.* In 3 patients the respiratory curve was not restored to normal after artificial ventilation, either because of the direct influence of the tumor on the respiratory center or because of the high intracranial pressure. Restoration of the normal regular respiratory curves in these patients took place after removal of a tumor of the 4th ventricle (one child) and after trephining and opening the dura (the second child). In the third patient, with a tumor situated within the brain stem, breathing was not restored to normal but remained irregular during the postoperative period.

The effect of normalization of the respiratory curves can be attributed mainly to the influence of artificial ventilation. The intracranial pressure did not fall during this period. In some cases it actually rose during induction and intubation [3, 10, 11]. It could be postulated, on the basis of M. V. Sergievskii's theory [5-8] that under the influence of anesthesia the influence of the cortex on the subcortex was reduced, and the respiratory curve there-

* No account was taken in this investigation of changes arising in respiration under the influence of the anesthetic, the surgeon's manipulations of the brain, bleeding, and so on.

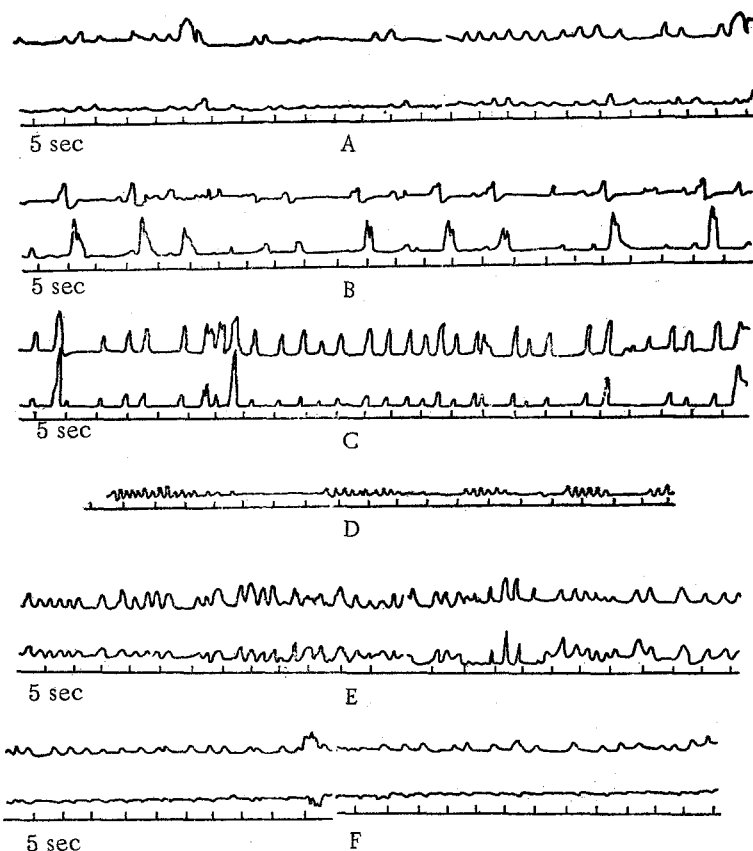


Fig. 1. Pneumograms before operation. On the double pneumograms the top curve is the abdominal respiration and the bottom curve the thoracic. A) Patient aged 10 years with medulloblastoma of the vermis and 4th ventricle (group 2); B) patient aged 10 years with astrocytoma of the vermis and the right cerebellar hemisphere (group 4); C) patient aged 6 years with sarcoma of the 4th ventricle (group 3); D) patient aged 5 years with sarcoma of the vermis and 4th ventricle (group 4); E) patient aged 8 years with arachnoidendothelioma of the right parieto-temporal region (group 3); F) patient aged 5 years with medulloblastoma of the vermis and 4th ventricle (group 3).

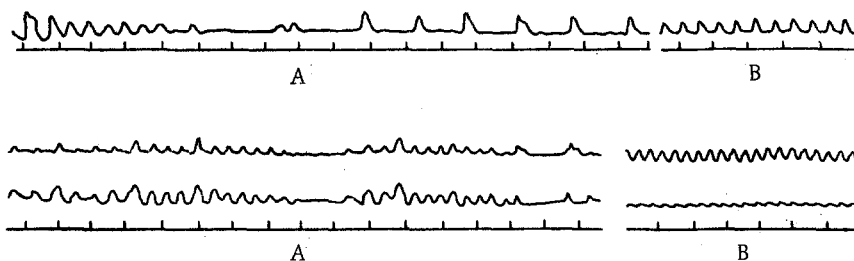


Fig. 2. Penumograms before operation. A) Patient aged 9 years with astrocytoma of the right cerebellar hemisphere (group 4) and patient aged 5 years with ependymoma of the 4th ventricle (group 4); b) same patients after controlled respiration.

fore restored to normal. However, even at the beginning of injection of barbiturates (in the period of induction), when patients were going under the anesthetic with dyspnea, the existing disturbances of the rhythm and amplitude of respiration appeared to be emphasized, and respiration was gradually depressed. In patients with respiratory disturbances detectable clinically, normalization of the respiratory curve may be explained by an improvement in the gas exchange during ventilation, in full agreement with the views of Ya. M. Britvan [1, 2], who considers that dyspnea is most frequently caused by hypercapnia combined with hypoxemia. However, changes in the rhythm of

respiration also appeared without any signs of hypoxia or hypercapnia. For instance, in 8 patients with irregular and uneven respiration or respiration of the biotype, the acid-base balance investigated by Astrup's micromethod was either normal, or showed a slight tendency towards metabolic acidosis. The pH remained within normal limits (7.35-7.42), and $p\text{CO}_2$ was lowered to 33-34 meq/liter, giving a base deficit of 6-11 meq/liter. After artificial ventilation and normalization of the respiratory movements, no definite changes took place in the state of the acid-base balance. Investigations of the acid-base balance in similar patients before operation, undertaken by V. L. Fantalova [9, 10], likewise revealed no disturbances.

Probably a role in the normalization of the respiratory rhythm after artificial ventilation is played by the arrival of nervous impulses at the respiratory center from the vagus nerve endings in the lung during artificial ventilation. The importance of this factor was demonstrated experimentally by V. S. Raevskii [4]. Artificial ventilation evidently has a dual influence on normalization of the activity of the respiratory center in the presence of dyspnea: it causes reflex stimulation of the respiratory center by impulses from the lung tissues and it improves the gas exchange.

SUMMARY

Pneumography was used to study the influence of artificial ventilation on the respiratory curve in 167 children with brain tumors under general anesthesia. In 117 patients with a normal respiratory curve before the operation, the respiratory curve showed no significant changes after artificial ventilation lasting 10-30 min. In 50 patients with various disturbances of the respiratory curve before the operation, artificial ventilation brought the respiratory curve to normal, except for three cases.

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