THE ACHIEVEMENT OF OPTIMAL BRAIN RELAXATION BY
HYPERVENTILATION TECHNICS OF ANESTHESIA*

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The problem of the swollen or tight brain is one that has plagued the neurosurgeon since the inception of intracranial surgery. Numerous attempts have been made to offset this condition by hypertonic solutions injected into the blood stream or by a physical approach such as hypothermia. To these technics we wish to add another technic which, in our experience, has proved quite satisfactory. We have used the technic of hyperventilation anesthesia since February 1958 for over 325 patients who have had intracranial procedures for various types of lesions. These lesions have been located both supra- and infratentorially. The application of the technic varies in relationship to the location of the lesion for which the operation is performed.

TECHNICS OF HYPERVENTILATION ANESTHESIA

Preanesthesia medication consists of a belladonna drug only. Opiates are not used on patients with intracranial lesions. To avoid respiratory depression during anesthesia, barbiturates are not administered within 12 hours of the operative procedure. The induction is accomplished with a minimal hypnotic dose of thiopental followed by nitrous oxide, oxygen and ether. Etherization is continued until the pupils of the eyes begin to dilate. At this time, the glottis and carina are cocainized. The gas, oxygen and ether mixture is continued until the cocainization is completely effective. Approximately 2 cc. of succinylcholine are administered and a cuffed endotracheal tube is inserted. Moderate overventilation is used just before the succinylcholine is administered. The same gas-ether mixture is continued immediately after intubation. Just before the patient is positioned for the procedure, the ether is discontinued and a 4-liter flow of nitrous oxide and oxygen (half and half) with 1 per cent halothane is used for maintenance of anesthesia. A muscle relaxant is administered intermittently to prevent the patient’s resistance to changes in ventilatory compliance. Variations in the technic of anesthesia may include halothane and gas for both induction and maintenance of anesthesia; following ether induction, increments of thiopental and a muscle relaxant may be used for maintenance of anesthesia. At this time, the ventilator is introduced into the anesthesia breathing system and the control of respiration is initiated. When the operative procedure involves the posterior fossa, the patient’s respiratory efforts are assisted rather than controlled.

One of several types of ventilators is used, of which the Bird unit seems most satisfactory for either assisted or controlled respirations. The minute-volume respiration is based upon the “Radford Nomogram.” We feel that an increase of 25 to 50 per cent above the rated minute-volume for the patient should produce adequate hyperventilation. The rule of thumb is that when the average patient shows expansion of the chest at the apices, hyperventilation is in effect. When the Bennett or Stephenson type of ventilator is used, plus 15 and minus 5 mm. of mercury pressures are recommended and for each 3-foot length of tubing, 100 cc. are added to the calculated stroke volume to compensate for the ventilatory dead space. When the Bird unit is used, this compensation is unnecessary. The desired effects of hyperventilation anesthesia upon the brain tissue are attained after approximately 45 minutes.

RESULTS

When the effect of hyperventilation has been well established, an unusual depth of the pia-arachnoid space is observed (Fig. 1). The brain is quiet, relaxed and feels rather compliant. If the full effect of hyperventilation has not been achieved, the pia-arachnoid space will not be observed to be enlarged and the consistence of the brain will be friable, resembling that of an infantile brain.

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fixed in formalin. Manipulation of the brain at this stage will damage the brain. The superficial cortical vessels appear normal to gross observation. There is no unusual sensitivity of the vessels upon manipulation as indicated by minimal vasospastic response. Approximately 50 to 75 cc. of cerebrospinal fluid can be aspirated from the parachiasmatic cisterns. Lumbar drainage rarely is necessary. Following removal of the cerebrospinal fluid, reduction in the volume of the brain tissue is apparent immediately (Fig. 2).

To prevent the unsupported dura mater from separating from the skull, it is important, at this point, to place tack-up sutures to hold it against the skull. With gentle retraction, the brain tissue is easily displaced to expose the lesion. Fig. 3 shows the visualization of an aneurysm of the anterior communicating artery as exposed through a small Dandy pituitary type of flap. Also visible are the anterior cerebral arteries, the optic nerves and the internal carotid artery with the retracting spatulas in place. Fig. 4 shows the

Fig. 1. Shows the fullness of the pia-arachnoid space. The right sylvian fissure runs almost vertically in the field.

Fig. 2. The brain falls away from the orbital roof and sphenoid ridge after partial drainage of the parachiasmatic cisterns.