Recent Validation of 133Xe Inhalation

To the Editor:

There have been a number of questions concerning the validity of regional cerebral blood flow from the brain stem and cerebellar regions recorded after inhalation of 133Xe after placement of probes in the subcortical region (see p. 203). These posterior fossa measurements have been a relatively new contribution from this laboratory and their validity may be questioned since detectors placed in the subcortical region may be subject to distortion from counts derived from nasopharynx, air sinuses and extracranial circulation.

Brain stem and cerebellar (BSC) rCBF measurements appear to be valid for the following reasons. In the baboon 133Xe inhalation measurements rCBF(inh) have been alternated with the aortic arch injection method rCBF(inj). The arterial bolus and inhalation measurements are in good agreement for the BSC regions as well as for the hemispheric values. In the baboon, chronic tracheotomy was performed to eliminate 133Xe contamination from the nasopharynx and the air sinuses. Measurements were made in a primate chair before, during induction, and recovery from different anesthetic or tranquilizing agents. EEG, PECO2, and blood pressure were recorded. Correlation coefficients between rCBF(inh) and rCBF(inj) were: r = 0.93 (P < 0.01) for hemispheric flow gray, r = 0.86 for BSC flow gray (P < 0.05).

Results obtained with Fg during different stages of responsiveness were: 1) deep barbiturate anesthesia; hemispheric Fg = 52 ± 8 ml/100g brain/min, BSC Fg = 48 ± 8.2, 2) light ketamine anesthesia, hemispheric Fg = 79 ± 12, BSC Fg = 73 ± 10, 3) awake after anesthesia, hemispheric Fg = 92 ± 17, BSC Fg = 87 ± 16, 4) unilateral sensory motor stimulation; Fg (stimulated hemisphere) = 101 ± 27, Fg (non-stimulated hemisphere) = 85 ± 9, BSC Fg = 105 ± 29. Finally, during brain death at MABP of 40 mm Hg, brain stem and cerebral flow was almost zero despite continued cardiopulmonary circulation with a satisfactory end-tidal 133Xe curve.

In man, after inhalation of 133Xe, gamma counts recorded from probes placed over the posterior fossa and directed toward the brain stem–cerebellar regions in the distribution of the vertebral-basilar arterial system, are comparable to those recorded from probes placed over the hemispheres in the distribution of the carotid artery. This is to be expected, since, unlike the carotid bolus method, inhaled 133Xe passes via the heart to perfuse the entire arterial system of the brain. Measurements of rCBF of the hind brain gave values for gray matter that are higher than values for the cerebral hemispheres although white matter flows are the same. The results are in good agreement with values reported in man with probes placed over the posterior fossa after direct injection of 133Xe into the vertebral artery and are consonant with brain stem and cerebellar flow values reported in animals.

Probes were fitted with 40 mm collimators and were placed at the midpoint of the 2 straight lines connecting the apex of each mastoid process with the occipital tuberosity. Anatomical studies post-mortem and by CT scanning show that the cone of resolution of the probes was directed through the cerebellum at the level of the dentate nucleus and toward the brain stem at the level of the 8th cranial nerve. When a point source of 133Xe was moved in the skull post-mortem in the anatomical regions seen by the probe the cerebellar hemisphere lay between the 25–100% isocount line and the brain stem between the 25–10% lines. However, as the volume of tissue seen by the probes increases as the distance from the probes increases, the ratio of counts from brain stem to cerebellum, read by the probes, is estimated to be 1:2 based on geometric reconstruction from the anatomical measurements.

The possibility of nasopharyngeal and sinus contamination was excluded further by BSC measurements in a laryngectomized volunteer, in whom there was no connection between the tracheal stoma and the nasopharynx. In this otherwise normal subject the curves, counts and BSC flow values were the same as in other normal volunteers. The validity of the brain stem flow was established in a young patient who had undergone excision of most of the left cerebellar hemisphere 4 years earlier for removal of a large acoustic neuroma. CT scans confirmed the cystic atrophy of the left cerebellar hemisphere. On the left side the counting rate was 37% below the normal side and the calculated flow values for Fg = 143 ml/100g brain/min for the left side (considered to be almost pure brain stem flow) and 102 for the normal side.

Finally, measurements of BSC flow during different states of consciousness and brain activity are in good agreement with those measured in the baboon during activation and different stages of anesthesia. The lowest Fg values of 44 ml/100g brain/min were recorded in semicoma, with stepwise increases with stupor, stage I and II sleep, drowsiness, rest in quiet darkness, rest with lights on and auditory stimulation, activation by talking, watching and listening to music, and REM sleep. The highest values of 184 ml/100g brain/min were found during generalized myoclonic seizures.

In conclusion, these studies indicate that it is possible to record satisfactory gamma counts derived from brain stem and cerebellum. We believe contamination of the counts derived from nasopharynx, air, venous sinuses and extracranial tissues of the scalp and neck muscles is negligible. The flow values obtained in man are in good agreement with values obtained in animals and show appropriate changes in clinical conditions known to involve these structures, such as the brain stem reticular formation.

JOHN STIRLING MEYER, M.D.
Chief, Cerebrovascular Research
Houston Veterans Administration Hospital
Houston, TX 77211

Omental Transposition to Human Brain

To the Editor:

Since submitting our article “Prevention of Cerebral Infarction in the Monkey by Omental Transposition to the Brain” (pp 224–229) a patient under experimental protocol has undergone omental transposition to the brain; thus demonstrating its technical feasibility. The clinical and physiologic effects of the operation are yet to be determined.

HARRY S. GOLDSMITH, M.D.
Dartmouth-Hitchcock Medical Center
Hanover, NH

Mechanisms of Anesthetic Action

To The Editor:

The article by W.E. Lightfoote et al. (Stroke 8: 627–628 1977) includes a serious error which should not have escaped critical review. A sentence in the second paragraph reads: “For example, nitrous oxide produces anesthesia by inducing generalized anoxia, . . . .” No anesthetic in current use depends on anoxia, either generalized
Recent validation of 133Xe inhalation.

J S Meyer

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