Echoencephalography as an Aid to the Diagnosis of Space-Occupying Lesions in the Posterior Fossa by Measuring the Size of the Third and Lateral Ventricles*

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Since 1955 when echoencephalography was first used by Leksell as a procedure to lateralize a space-occupying supratentorial mass, it has gained wide application through the world. The possibilities for diagnosing tumors in the posterior fossa or abnormalities of the aqueduct of Sylvius are much less well known. Even Leksell in his first publication on echoencephalography presumed that the ventricular walls would also reflect ultrasound. In 1959, de Vlieger and Ridder obtained echoencephalograms with a double reflection from the lateral walls of the third ventricle. In 1961, Lithander was able to diagnose enlargement of the ventricular system in children using ultrasound. Jeppsson in his monograph of 1961 was of the opinion that the echo method was not of value with posterior fossa lesions. Even within the last 2 years, reports have been published that do not recognize the value of A-scan echoencephalography with such lesions. Investigations using B-scan to demonstrate the enlarged lateral ventricles have been performed only rarely.

Methods

The use of A-scan echoencephalography for measuring the width of the third ventricle is not limited to children and juveniles with a thin skull bone. In adults, also, the sonic energy reflected from the boundaries between the ventricular walls and the cerebrospinal fluid is sufficient to penetrate the skull bone in the temporal region and to give usable reflections on the cathode-ray tube screen, especially in the case of an enlarged ventricular system with the ultrasonic beam striking the boundaries vertically. In many cases, the reflections of the third ventricle walls have a higher amplitude than that of the calcified pineal body. We are reporting a series of 454 echoencephalograms made on 156 patients, mostly adults, who had tumors of the posterior fossa or chronic stenosis of the aqueduct (Fig. 1).

The technique of A-scan echoencephalography is illustrated in Fig. 2. The probe is first applied directly above the ear (Position 1); the double reflection of the third ventricle becomes visible, and the distance between the two echoes corresponds to the diameter of the third ventricle. The probe is then directed a little downward (Position 2) so that reflections are also obtained from the temporal horn. In most cases, the lateral wall of this ventricle produces the higher echo because of the concavity of the reflecting plane. The probe is then placed 12 cm above the ear (Position 3), to receive the midline echo from the posterior part of the septum pellucidum or from the calcified pineal body. The position of the temporal-horn echo on the ultrasonogram represents a good standard for the degree of ventricular enlargement. To simplify the evaluation of echoencephalograms in patients with dilated ventricles, we defined a brain-mantle-index

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FIG. 2. Echoencephalographic investigation technique in cases of hydrocephalus: 1) measurement of the third ventricle (3.V.), 2) measurement of the opposite temporal horn (TH), 3) measurement of the midline structures (M).

(BMI),\(^{28}\) based on the distance from the midline echo to the end echo related to the distance from the lateral temporal horn echo to the end echo (Fig. 3). We then paired the degree of ventricular dilatation to the brain mantle index in each case, and found an index rate of 2.2 to be normal (Fig. 4). Posterior fossa tumors caused average rates of 2.6 to 3.2. Higher rates were unusual and were observed only in infants and patients with occlusion of the aqueduct. The good agreement between the BMI measurements and the width of the third ventricle as determined by the echograms is shown in Fig. 5.

We also checked the exact agreement between echoencephalographic and pneumoencephalographic measurements by measuring the diameter of the third ventricle by the two methods in 56 cases (Fig. 6). The measurements of the ventriculogram were 25 to 35% larger than those of the echogram, probably due to the dispersion of x-rays. The ultrasonic investigations were carried out 1 or 2 days before the operative ventriculography. It is evident that echoencephalography is a reliable method of measuring the width of the third ventricle. Complete conformity was also found when comparing echoencephalographic results with brain specimens in some postmortem studies.

The same results were true for the measurement of the temporal horn echo. Ventriculotomograms checked against the echoencephalograms of the same patients showed that the high reflections before the end echo correspond to the lateral wall of the temporal horn (Fig. 7).

**Results**

Since 1962 we (Neurosurgical Department of Erlangen-Nuremberg University) have taken echoencephalograms in more than 2,500 patients with cerebral diseases and brain injuries. Among these were 156 pa-

**Fig. 3.** Evaluation of the echoencephalographic brain-mantle-index (BMI): \(M = \text{midline echo, } E = \text{end echo, } a = \text{distance between midline echo to end echo, } b = \text{distance between lateral temporal horn echo to end echo.}**