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CT Assessment of CSF Spaces in the Brain in Demented and Nondemented Patients over 60 Years of Age

Knut Kohlmeyer[1] and Abdel Raman Shamena[1, 2]

To obtain data about the size of the third ventricle, the lateral ventricles, and the cortical sulci in dementing diseases, computed tomography was performed on 300 patients over 60 years of age. Half of these patients were demented; half were not. Measurements were made to determine the width of the third ventricle, the Huckman number, the ventricular index, and the cella media index. The largest sulci in the frontal, temporal, and parietal areas were also measured; the sum served as an approximate sulcal index. The subjects were divided into 5 year age groups. The mean values in each group were determined and compared by the Student t test. In the nondemented groups there was an increase of the width of the cortical sulci corresponding to increasing age. There was no statistical difference in the sulcal measurements of the demented and nondemented groups except in the 60–69 age groups. The third ventricle enlarged with increasing age, but the enlargement was statistically significant only in the demented group. The strongest statistical relation occurred in the lateral ventricles, which were of normal size in the nondemented group and markedly enlarged in the demented group.

There are many communications dealing with computed tomographic (CT) methods of measuring the normal ventricular system. A few consider the cortical sulci and the age-dependent width of the inner and outer cerebrospinal fluid (CSF) spaces [1–6], but correlative studies to obtain values on the ventricular and sulcal size of demented and nondemented individuals over 60 years of age are rare [7–9]. A review of several CT efforts to measure CSF spaces was published recently by Sabattini [10].

Subjects and Methods

CT was performed on 300 subjects over 60 years of age, half with and half without dementia. The following measurements were obtained: the width of the third ventricle at the level of its widest diameter; the Huckman number (sum of the greatest and the smallest distances between the frontal horns); the ventricular index (calculated as the quotient of the widest distance of the choroid plexus of the lateral ventricles and the widest distance of the frontal horns); the cella media index (calculated as the quotient of the largest biparietal diameter measured from tabula externa to tabula externa and the largest width of the cella media; and the width of the cortical sulci (the sum of the measurements of the widest sulcus frontally, temporally, and parietally).

All the above figures were tabulated, and the mean values and standard deviations were determined for each category by age group and dementia condition. Statistical analysis was done by the Student *t* test. The number of subjects in each group and their mental conditions are listed in table 1. The overall mean age of the nondemented group was 73.3 years and of the demented group 74 years. The youngest subject was 60 years old, and the oldest 98.

The nondemented group was not composed of completely healthy subjects. Clinical diagnoses in this group included endogenous or reactive depression, neurosis, and headache. Patients with a history of drug or alcohol abuse, epileptic seizures, head trauma, transient ischemic attacks, or strokes were excluded from the study.

Results

The mean brain measurements and indices, standard deviations, and the results of statistical calculations are listed in table 1 according to age group and mental condition.

Discussion

Our results show that the width of the third ventricle is increasingly age-dependent in nondemented persons from 60 to over 90 years of age. This was pointed out by Grumme [11], who relied on echoencephalographic studies. We agree with his statements that normal values of the third ventricle should be indicated only in relation to age, and that a reliable normal value of the third ventricle is hard to estimate for anyone over 75 years of age because of the broad standard deviations in this age group. The work of Gyldensted and Kosteljanetz [2] shows the size of the third ventricle is age-dependent in nondemented adults also.

There is general agreement concerning the lateral ventricles. They normally do increase in width in relation to age [1–4]. But this holds true only for mean values. There are many nondemented individuals over 70 years of age who have small lateral ventricles. Although the mean inner CSF spaces become wider after the age of 60, we have never calculated a mean value that exceeds the maximum values given by many researchers [1, 4, 11].

It is more difficult to deal with the cortical sulci. There are no standard criteria to evaluate findings in normal and pathologic cortical sulci. There is only general agreement that cortical sulci should not be visible on CT scans of children, adolescents, and young adults, and that the sulci become increasingly evident with age [3, 5].

[1]Department of Neuroradiology, Central Institute of Mental Health, P.O.B. 5970, 6800 Mannheim 1, West Germany. Address reprint requests to K. Kohlmeyer.

[2]Present address: Department of Neurology, Ludmillen Hospital, 4470 Meppen, West Germany.

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TABLE 1: **Mean Brain Measurements and Indices in Demented and Nondemented Elderly Patients, by Age**

Age Range: Condition	Mean Values (±SD)				
	Third Ventricle (mm)	Huckman No. (mm)	Ventricular Index	Cella Media Index	Cortical Sulci (mm)
60–64:					
Nondemented (n = 29)	5.4 (0.58)	47.4 (3.5)	1.8 (0.12)	4.8 (0.27)	10.3 (3.3)
Demented (n = 25)	9.5* (3.8)	63.8* (4.9)	1.3* (0.09)	3.4* (0.28)	18.3† (8.7)
65–69:					
Nondemented (n = 27)	6.5 (1.4)	49.6 (3.8)	1.9 (0.17)	4.8 (0.86)	14.3 (3.6)
Demented (n = 26)	9.1* (3.1)	64.9* (7.2)	1.4* (0.13)	3.8† (0.40)	18.0‡ (4.1)
70–74:					
Nondemented (n = 40)	7.9 (1.4)	50.0 (5.0)	1.8 (0.20)	5.0 (0.75)	15.3 (3.9)
Demented (n = 39)	11.2* (4.2)	69.6* (8.1)	1.3* (0.13)	3.5* (0.33)	17.4 (3.6)
75–79:					
Nondemented (n = 35)	8.0 (2.0)	51.2 (5.1)	1.8 (0.17)	4.9 (0.90)	16.3 (4.0)
Demented (n = 41)	11.1* (3.0)	68.4* (9.9)	1.3* (0.19)	3.5* (0.42)	18.0 (4.7)
80+:					
Nondemented (n = 19)	8.7 (2.0)	52.0 (4.0)	1.8 (0.09)	4.8 (0.07)	17.7 (4.0)
Demented (n = 19)	11.4‡ (1.8)	70.5* (5.6)	1.2* (0.15)	3.4* (0.24)	18.1 (5.3)

Note.—Overall mean values were: third ventricle, <8 mm; Huckman no., <52 mm; ventricular index, >1.6; cella media index, >4.
* $p < 0.01$.
† $p < 0.01$.
‡ $p < 0.05$.

Using our method to measure the cortical sulci, there is no doubt that they do get larger between ages 60 and 100 in nondemented individuals. We can also establish that a statistically significant difference in the width of the cortical sulci occurs from 60 to 69 years of age, and that such differences no longer exist past 70 years of age, independent of the presence or absence of dementia. The fact that there is no correlation between so-called cortical atrophy and dementia has been pointed out by Claveria et al. [7], Wells and Duncan [12], and de Leon et al. [9].

We cannot agree with Meese and Grumme [6], however, who emphasized that enlargement of the cortical sulci would be the most reliable parameter for diagnosing cerebral atrophy, at least not as far as elderly patients are concerned. This statement is correct only if one includes in the diagnosis of cerebral atrophy the physiologic diminution of cortical tissue in old age without the findings of intellectual performance.

The cortical atrophy tables of Meese and Grumme [6] show that the cortical sulci enlarge with age. However, there is no mention of whether they compared clinical findings with CT diagnosis. According to our statistical calculations of their data, there is a strong, statistically significant relation between the clinical diagnosis of dementia and the mean values of the inner CSF spaces. The differences found between the demented and nondemented groups in the width of the third ventricle, the Huckman number, the ventricular index, and the cella media index are considerable for all age groups. The mean values of the inner CSF spaces of demented patients are not only significantly higher than those of the nondemented groups statistically; they also clearly exceed the normal values of all age groups. There is a correlation between brain atrophy measured by ventricular dilatation on CT scans and evidence of mental impairment on psychometric tests [7, 9], but there is no correlation between the degree of atrophy and the severity of the mental impairment. This was also true in our study. Therefore, we cannot share the pessimism of some authors [8] who deny correlations in older patients between CT enlargement of the lateral ventricles and intellectual impairment or dementia.

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