Original Article

C.T Scan Measurements of the Lateral and Third Ventricles in Apparently Normal Iraqi Subjects

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Summary:

Background: Cerebral ventricular enlargement has been associated with many neurological disorders. Whether this enlargement is primary or secondary to these pathological conditions remains controversial. To define such enlargement, one must have measurements in normal subjects (controls).

Patients and methods: One hundred-twelve (66 male and 46 females) apparently healthy normal subjects, with age ranging between 10-69 years were subjected to C. T scans as part of routine diagnostic workup for complaint of headache or recent minor motor-vehichle accident The ratio (measured as percent) of the ventricular-cross area of the lateral ventricle The maximum width (MTW) of the third ventricle was also determined. The data collected .was statistically analyzed.

Results: Measurements of VBR ratios and MTV in both males and females of the normal groups revealed no significant difference. No significant difference in VBR ratio and MTW was noticed till the age of 49 years. Significant differences were noticed between 49-69 years of age.

Conclusion: Abnormalities of the cerebral ventricular sizes are more easily identified in the Young than that found in old persons.

Keywords: Computerized tomography scan (CT scan), ventriculo-cerebral ratio (VBR %), maximum cerebral third ventricle width (MTW).

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Introduction:

Attempts have been made in the past to establish a relationship between the cerebral ventricles and skull or brain size in normal subjects (1, 2).

The advent of CT scanning resolved the problem of volumetric measurement performed on normal subjects (3). The ventricles of the brain are well visualized, and their overall configuration can be reconstructed from a series of contiguous slices (4). The evaluation of the normal measurements of the cerebral ventricles in the living human has great importance in the diagnosis and monitoring of several pathologies (5). Accurate measurements of the ventricles provide available and safe means of aiding the diagnosis of some neurological disorders such as early detection of hydrocephalus, cerebral atrophy….etc, and provide important follow up information in affected patients (6). It should be noted that there is a continuous debate in the literature of neuro-anatomy, psychiatry, neuro-radiology and neurology over the best method of assessing the various parts of the cerebral ventricular system (7). To date, ventricular size on CT scanning is assessed in two ways:; either subjectively or objectively by time consuming methods (8).

Patients and Methods: One hundred-twelve (66 males and 46 females) apparently healthy normal subjects, age range between 10-69 years were chosenfor this study. These subjects had undergone CT scans as part of routine workup for complains of headache or recent minor motor-vehicle accident. They had no positive neurological findings and were reported normal by neurologists. Furthermore, they had no past history of chronic alcoholism, dementia, head injury, epilepsy, meningitis, encephalitis, nor their CT scans revealed any abnormalities such as intracranial mass, infarct, a haemorrhage, cerebral atrophy or hydrocephalus, and all were read as normal by a neuro-radiologist. Subjects were categorized into six groups according to their ages, as shown in table:

Table-1: The age groups and number of 112 normal subjects.

Groups	Age range (years)	Subjects number
A	10-19	20
B	20-29	20
C	30-39	20
D	40-49	20
E	50-59	20
F	60-69	12
Total	10-69	112

Non contrast axial CT scans were performed in the routine fashion on all selected subjects. Manually, the perimeter of the lateral ventricles and that of the whole brain as seen was circumscribed on a millimeter-square paper by projecting CT film on the square-paper. We have also assessed the above measurements when counting the cross-sectional area of the lateral ventricle and that of the whole brain on the same level by copying the same CT film on a millimeter-square paper using the computer scanner. The correlation coefficient between the two

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readings (manual and scanner) was 0.95 ($p \leq 0.001$). The VBR percent of lateral ventricles was calculated using the following formula:

$$VBR\% = \frac{\text{Ventricular cross-sectional area}}{\text{Brain cross-sectional area}} \times 100\ \%$$

The (MTW) at the foramen of Monro was measured directly on the monitor of the CT scanner.

Result: Means VBRs and MTVs were apparently larger in men than that of their women counterparts. However, no significant difference was found statistically between the two sexes in the total sample studied (table-2).

Table-2: The details of sex difference in the VBR and WTV of total sample

	VBR Mean± SD	WTV Mean ± SD
Female (N0= 46)	4.159±1.22	2.167±0.578
Male (N0=66)	4.528±1.154	2.390±0.649
Total= 112	4.376±1.213	2.298±0.619
T value	1.703	1.871
P value	0.092	0.064

Table-3: Measurements and statistical details of the VBRs and max. WTV of the various age groups.

Age Groups (years)	Means ± Sttd. Deviation Std.Error of Means	VBRs %	Max. WTV (mm)
A 10-19	Mean	3.317	1.9485
	Std. Deviation	0.61628	0.12942
	Std. Error of Mean	0.13780	0.02894
B 20-29	Mean	3.5925	2.0395
	Std. Deviation	0.51664	0.17503
	Std. Error of Mean	0.1552	0.03914
C 30-39	Mean	4.0050	2.2105
	Std. Deviation	0.95337	0.45216
	Std. Error of Mean	021318	0.0.10111
D 40-49	Mean	4.3950	2.4370
	Std. Deviation	0.70672	0.58863
	Std. Error of Mean	0.15803	0.13162
E 50-59	Mean	5.2750	2.8730
	Std. Deviation	0.68739	0.41520
	Std. Error of Mean	0.15370	0.09284
F 60-69	Mean	6.4833	3.3250
	Std. Deviation	0.86742	0.72001
	Std. Error of Mean	0.25040	0.20685

There was a gradual increase in the VBR of the lateral ventricles and maximum WTV after the age 49 years. However, this increase was much sharper after the age of 59 years. No significance of difference in VBRs and maximum WTV between groups A, B, C, and D. However, significant difference was found

Discussion:

In the past, there were many trials for measuring the size of the cerebral ventricles. Individual variation in the size of the ventricles is large and, therefore unreliable when read alone (9, 10). The relation of the cerebral ventricular system to that of the brain tissue as a whole may, therefore, provides much less error and can be considered more reliable (11). Nevertheless, in the case of the third ventricle measurements, linear measurements were considered only because of the relatively small size of this ventricle, which at many occasions, it appeared a slit-like only and thus area measurement could not be applied in this situation (12). Sabattini, 1987and Delsi, 1988 have argued that measurements through the maximal width of the frontal horns of the lateral ventricles gave more reliable measurements (5, 6). With regard to the nature of the groups studied in this work, we believe that normal healthy volunteers should be used instead of neurological cases that were reported normal by the neurologist. Normal healthy volunteers are difficult to enrole in such studies because the CT scans are costly. However, in our study and as in some other studies the normal group consisted of neurological patients with normal CT scans and reported as normal by neurologist (13). It is noteworthy to mention that in this study and previous studies, ventricular enlargement is simply as statistical definition (14). It is possible to be assumed that by combining a measurement of brain structure such as ventricular size with the clinical picture of that neurological or psychiatric disorder may provide a useful approach to the classification or criteria setup of that disorder. Significant sex-related differences in measurements of the ventricular system, using a rather small sample of adults, were reported by Gyldensted and Kosteljanetz, 1976. Furthermore, Williams et al., 1985 have reported lower VBR in women than in men (15, 16). However, the results of our present study have shown no significant difference between male and female VBR and maximum WTV. The reason behind this discrepancy would attribute to the larger size of sample used in this study. Following the age 49 years there was slight increase in the VBR and maximum WTV then at the age of 59 years there was sharp increase in VBR and WTV in both sexes and significant difference if compared with ages bellow 49 years.

Brain atrophy, as a normal degenerative process, starts after the age of 49 years and start early in deep structures of the brain before cortex.

Brain ventricles enlargement are not specific finding after the age 49 years since it is common in normal elderly and in many neurological disorders, but it may help in diagnosis of some neurological disorders bellow the age of 49 years.

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