

CT MEASUREMENTS OF TWO CEREBROVENTRICULAR INDICES AND THEIR RELATION WITH AGE

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ABSTRACT

BACKGROUND

Cerebroventricular Indices are the relative measurements of the size of lateral ventricle to that of brain. A normal study of these indices are necessary in order to understand any changes in size of the ventricles or other associated abnormalities of the brain. The study uses measurements from Computerised Tomography (CT) which is uniformly calibrated, has reproducible data and is less expensive than MRI.

MATERIALS AND METHODS

CT scans of 186 apparently healthy normal individuals of age group 1 to 85 years were taken and the subjects were categorized into age intervals of 10 years; males and females taken separately. The linear measurements of lateral ventricle and brain were taken directly from the screen. The cerebrovascular indices were calculated. The mean values in each group were compared with age and sex, using appropriate statistical tests.

RESULTS

Mean value for Bifrontal index was 0.31 ± 0.03 and that of Bicaudate index was 0.12 ± 0.02 . Both indices showed a positive correlation with age. The relative size of the lateral ventricle with the brain did not show any gender difference.

CONCLUSION

The study results coincide with previous similar studies. Both the indices showed positive correlation with age, of which the Bicaudate index was more sensitive.

KEYWORDS

Lateral ventricles, Cerebroventricular Index, Computerized Tomography (CT).

HOW TO CITE THIS ARTICLE: Puthanveettil A. CT measurements of two cerebroventricular indices and their relation with age. *J. Evid. Based Med. Healthc.* 2017; 4(6), 303-306. DOI: 10.18410/jebmh/2017/57

BACKGROUND

Changes in brain with ageing has been the focus of many studies; the increase in size of lateral ventricle being one among them. Being a space, lateral ventricles can be studied in the living with the help of imaging techniques like Computerized Tomography (CT) and Magnetic Resonance Imaging (MRI). Cerebroventricular indices used in the study are the ratios of width of lateral ventricles to that of brain at two levels. The linear measurements used in the study are easy to take & the index can be calculated with less technical skill. Being a ratio it ensures the independence of the results of the present study from particular scale factors used in sizing up the CT scan images as well as from the units of measurements employed. It also reduces the influence of variations due to anthropometric differences in normal individuals.

Financial or Other, Competing Interest: None.
Submission 28-12-2016, Peer Review 02-01-2017,
Acceptance 12-01-2017, Published 18-01-2017.
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 DOI: 10.18410/jebmh/2017/57



Aims and Objectives

Aim of the present study is to find out the change in lateral ventricular size with age in a defined population in Kerala.

Objectives are to calculate the Bifrontal & the Bicaudate Indices of Lateral Ventricles from CT scan films and to correlate the indices with age in males & females.

MATERIALS AND METHODS

One hundred and eighty six (N=186) apparently healthy normal subjects (Males-113 & Females - 73) of age group 1 to 85 years.

Inclusion Criteria

Patients underwent CT scans for various reasons like chronic head ache, vertigo, dizziness, to rule out intracranial haemorrhage or cerebral metastases and reported normal by the radiologist are taken for the present study.

Exclusion Criteria

The patients with intracranial haemorrhage, space occupying lesions of brain or intracranial surgeries were excluded from the study.

The measurements were taken directly from the computer screen using transparent calipers in mm scale from the axial sections of head showing the lateral ventricles from a series of sections taken 8 to 10 mm thickness.

The Cerebroventricular indices were calculated from the linear measures taken at two levels, and are named Bi Frontal Index (BFI) and Bi Caudate Index (BCI).

1. BFI is calculated by dividing the distance between frontal horn tip of lateral ventricle by the width of brain at that level.
2. BCI is calculated by dividing the width of lateral ventricles at the level of caudate nucleus by the width of brain at that level.

The statistical analysis was done by appropriate tools to find out the following– a) Any statistically significant difference between males and females for the indices (BFI & BCI) calculated using Independent sample t test, b) Any significant correlation for the indices with the age using Scatter diagram and c) Any significant difference for the

indices between the age group using ANOVA and Post Hoc test.

RESULTS

The Bi Frontal Index (BFI) varied from 0.21 to 0.39, with a mean value of 0.31±0.03 (Table 2). The BFI showed a statistically significant positive correlation with age (Figure 1). The Bi Caudate Index (BCI) varied from 0.06 to 0.20, with a mean value of 0.12±0.02 (Table 2). The BCI also showed a statistically significant positive correlation with age (Figure 2). The increase in ventricular size was gradual in early decades starting from 4th decade and more striking from 7th decade onwards (Table 4). The indices were calculated in males & females separately, but no significant difference was found statistically between the two sexes (Table 1).

	Sex	N	Mean	Std. Deviation	T	Sig. (2-tailed)
BFI	Male	113	0.32	0.03	.407	.685
	female	73	0.31	0.02	.409	.683
BCI	Male	113	0.12	0.02	-.788	.431
	Female	73	0.13	0.02	-.793	.429

Table 1. Statistical Correlation between the Sexes

	N	BFI				BCI			
		Mean	Std. Deviation	Min	Max	Mean	Std. Deviation	Min	Max
1-10	18	0.31	0.02	0.26	0.35	0.08	0.02	0.07	0.13
11-20	26	0.30	0.02	0.27	0.35	0.09	0.02	0.06	0.13
21-30	32	0.31	0.02	0.26	0.35	0.10	0.02	0.08	0.14
31-40	28	0.32	0.02	0.27	0.38	0.11	0.02	0.09	0.15
41-50	24	0.31	0.04	0.21	0.38	0.12	0.02	0.10	0.17
51-60	21	0.31	0.02	0.25	0.35	0.13	0.02	0.09	0.18
61-70	16	0.32	0.03	0.27	0.37	0.14	0.03	0.11	0.19
71-80	15	0.33	0.03	0.28	0.37	0.15	0.02	0.13	0.19
81-90	6	0.34	0.03	0.30	0.38	0.18	0.03	0.13	0.20
Total	186	0.31	0.03	0.21	0.38	0.12	0.02	0.06	0.20

Table 2. Minimum, Maximum, Mean and SD of BFI & BCI in different Age Groups

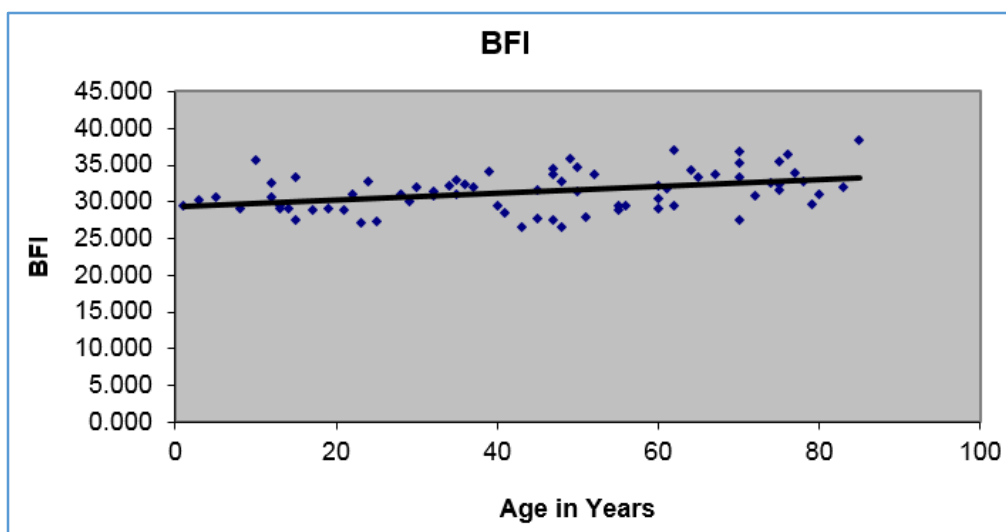


Figure 1. Distribution of Bi Frontal Index (BFI) against Age

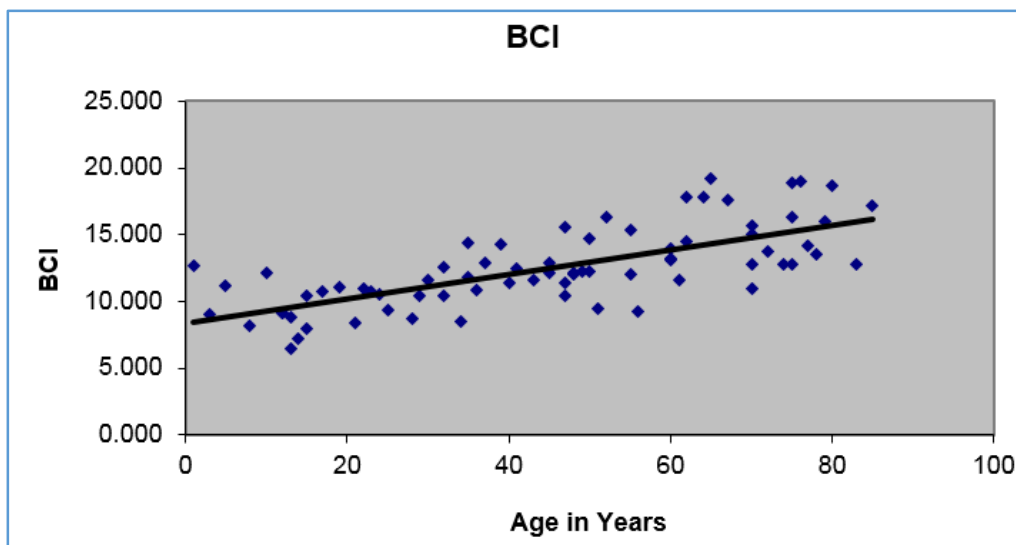


Figure 2. Distribution of Bi Caudate Index (BCI) against Age

BFI	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	172.512	8	21.564	3.093	.003
Within Groups	1233.917	177	6.971		
BCI	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	987.684	8	123.460	30.183	.000
Within Groups	724.000	177	4.090		

Table 3. Significance in Ventricular Size Changes between Age Groups

	1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90
1-10									
11-20									
21-30									
31-40	(*)	(*)							
41-50	(*)	(*)	(*)						
51-60	(*)	(*)	(*)						
61-70	(*)	(*)	(*)	(*)	(*)				
71-80	(*)	(*)	(*)	(*)	(*)	(*)			
81-90	(*)	(*)	(*)	(*)	(*)	(*)	(*)	(*)	(*)

Table 4. Post Hoc test for Difference in Means between Decades

DISCUSSION

The CT scan of brain is accepted as a valuable procedure for the evaluation of cerebral ventricular size.¹ It can be assessed by many methods like linear, planimetric and volumetric measurements. The latter two are too expensive & time consuming. They require large additional computation facilities. Whereas the linear measurements are easy to take, comparable & uniform methods be applied, it can be used for research purposes & for routine assessment of ventricular size in the scans.² The relative size of the ventricular system to that of the brain, used in the present study, provides less error and can be considered more reliable than the linear measurements of the ventricles.³ The quantitative criteria developed for normal lateral ventricular dimensions are expressed as cerebroventricular ratios or indices in order to minimize the potential influence of individual anthropometric measurements.⁴

Both linear & planimetric CT measurements assessing the size of cerebral ventricles in the previous studies reported almost similar results– a statistical slight progression in size of lateral ventricles beginning at the fourth decade and a more striking increase after the sixth decade.^{2,5,6,7} According to D’Souza et al⁸ the brain regression involving cerebrum usually begins in the 7th decade and thereafter accelerated with advancing age.

BFI & BCI were first described by Hahn & Rim in 1976.¹ They described it the bifrontal CVI and bicaudate CVI respectively. The BFI in their study varied from 0.19 to 0.39 with a mean of 0.31±0.04 in 200 patients 10 – 81 years old. Renata Wilk et al⁹ calculated the BFI in younger age group 1 to 18 years and found the values were between 0.27 and 0.38 with a mean 0.31± 0.03. The same index measured by D Poudel et al¹⁰ using MRI in 150 normal subjects, ranged between 0.25 and 0.35 with a mean value of 0.31±0.02. In the present study the range in values of BFI is almost same

as the previous studies reported, the mean value being 0.31 ± 0.03 .

BCI was found more sensitive in showing the age changes than other linear ratios.¹¹ Hahn & Rim noted the values of BCI varied between 0.08 and 0.23 with a mean value of 0.15 ± 0.03 . In a study done by Renata Wilk et al⁹ the BCI was between 0.06 and 0.12. Pelicci et al¹² considered the ratio to be abnormal if >0.17 and a definite enlargement if >0.20 , and his values were between 0.06 and 0.19 with a mean value of 0.11 ± 0.03 . The BCI values in present study (0.06 – 0.20) were similar to the study of Pelicci et al. & the values in the paediatric age group (0.06–0.13) was the same as Renata Wilk et al. The morphometric analysis of brain & ventricular system especially Lateral ventricle recently become the focus of interest in some neuropsychiatric diseases like Alzheimer's, Schizophrenia and Seizures of undetected origin. To understand these changes, the size of normal ventricular system of brain is important. The present study followed the simple measurements made on CT images to calculate and compare the ventricular size with age in a defined population in Kerala and it was comparable with the previous studies reported.

CONCLUSION

Present study aimed to study the size of normal lateral ventricles of human brain with two cerebroventricular indices and to find their relationship with ageing. The findings in the present study were coinciding with the values of previous similar studies. Both the indices showed a positive correlation with age, the index at Bicaudate level being more sensitive to increasing age.

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