

Study on Thickness of Gray Matter of Cerebellum in Bangladeshi Cadaver

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Abstract:

Context : *Cerebellum is a central part of the major circuit that links sensory to motor areas of the brain, and is required for the coordination of fine movement. So with these importance the aim of the present study was done on the thickness of gray matter of cerebellum to make a standard for Bangladeshi population.*

Study Design: *cross sectional analytical type of study*

Place & period of study : *Department of anatomy Mymensingh Medical College from April'2009 to September'2009*

Materials & Method ; *30 (thirty) relatively fresh cerebellum was collected from dead bodies autopsied at the autopsy laboratory of department of Forensic Medicine and prenatal cases from Gynaecology and Obstetrics Department of Mymensingh Medical College, Mymensingh after getting permission from concerned authority.*

Out of them 20 postmortem human cerebellum collected from Bangladeshi cadavers of both sexes (male 10 and female 10) age ranging from 5 to 60 years and 10 cerebellums from caesarian section of intrauterine death cases of both sexes (male 6 and female 4) age ranging from 34 wks to 41 wks. of gestation

The collected samples were grouped into three age groups like group A (34 to 41 weeks of gestation), Group B (5 to 30 years) and group C (31 to 60 years) and two sex groups (male and female). 10 cerebellums were studied from each age group for this histological study. Sections were processed following standard histological procedure and were stained with Hematoxylin and Eosin stain. Slides were examined under 15X4 magnifications and measurement of thickness of gray matter at foliar summit and at the depth of fissure of cerebellum were taken with the help of ocular micrometer. The study was approved by the ethical review committee of Mymensingh Medical College.

Result : *In this study, The mean difference of mean thickness of gray matter at foliar summit and at the depth of fissure between groups A&B and groups A&C was statistically highly significant ($p < 0.001$) but mean difference between groups B&C statistically was not significant.*

Key words: *Cerebellum, Gray matter, Thickness, Bangladeshi cadaver.*

Introduction:

Cerebellum is the largest part of hindbrain, situated in the posterior cranial fossa, behind the pons and the medulla oblongata.^{1,2,3,4} The cerebellum is a central part of the major circuit that links sensory to motor areas of the brain, and is required for the coordination of fine movement. In health, it provides corrections during movement, which are the basis for the precision and accuracy, and it is critically

involved in motor learning and reflex modification. It receives sensory information through spinal, trigeminal and vestibulocerebellar pathways and, via the pontine nuclei, from the cerebral cortex and the tectum. Cerebellar output is mainly to those structures of the brain that control movement. Cerebellum enlarges enormously during first year of life then the rate of growth is slow. The increase in volume is partly due to increase in the size and, not in number, of the nerve cells and partly by the growth of the blood vessels, but it is mainly affected by the progressive myelination of the nerve fibres.⁴

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Cerebellar cortex consists of three layers – outer molecular, intermediate Purkinje and inner granular.⁴ It contains more nerve cells (neurons) than all the rest of the brain combined, on an average 50 billion neurons.^{2,4} Purkinje cells form the center of a functional unit of the cerebellar cortex. They are flask-shaped and are arranged in a single layer.⁵ The total number of neurons in human cerebellum during development decreased significantly from early maturity to old age.^{6,7,8} Studies of the structural-functional organization of different parts of the cerebellum continue to be relevant. The variety of cerebellar functions and the conditions associated with their impairments have led to multilateral studies of this organ. The neuronal organization of the cerebellum has been studied in detail by a number of authors. However, despite the significant number of reports addressing the structural organization of the cerebellum, most of these have been performed on animals but the thickness of gray matter in humans remains inadequately studied. It has been observed by various workers that, dimensions of different organs in Bangladeshi population vary from those of western population. With the above evidences, the aim of the present work was done on the thickness of gray matter of cerebellum to make a standard for Bangladeshi population.

Materials and Methods:

The study was done by examining 30 (thirty) cerebellum out of them 20 postmortem human cerebellum collected from Bangladeshi cadavers of both sexes (male 10 and female 10) age ranging from 5 to 60 years and 10 cerebellums from caesarian section of dead fetuses of both sexes (male 6 and female 4) age ranging from 34 to 41 wks. Specimen containing cerebellum was collected from dead bodies autopsied on different dates from April'2009 to September'2009 at the autopsy laboratory of department of Forensic Medicine and Gynaecology and Obstetrics Department of Mymensingh Medical College, Mymensingh. The collected sample was grouped in to three age groups like Group A (34 to 41 weeks of gestation), Group B (5 to 30 years) and Group C (31 to 60 years). Histological study was done on 10 cerebellum of each age group. Small pieces of tissue were taken

and fixed in 10% formol saline. Size of the tissue was not more than 2 cm sq. and not more than 4-5mm thick. Sections were processed following standard histological procedure and were stained with Hematoxylin and Eosin stain. One good slide prepared from each tissue block was chosen for study. 10 slides from 10 different cerebellums were taken from each age group. Thus 30 slides were examined under 15 X 4 magnification. From each slide, 5 fields were chosen for counting the number of Purkinje cell. Thus in total 50 fields were examined from 10 slides of each age group. Measured thickness of gray matter at the summit of the folium and at the depth of the fissure between folium (15X4) of cerebellum were put down in a tabulated form for processing which led to a conclusion. Appropriate statistical analysis was done using computer based statistical package, SPSS (Statistical Package for Social Science) to evaluate the significance of variance between the different findings.

Ethical clearance : The study was approved by the ethical review committee of Mymensingh Medical College.

Results:

In this study, significant differences were observed in the thickness of gray matter in different age groups and also in the foliar summit between sexes but no significant differences were observed in the depth of the fissure between sexes. The details of observations and measurement are shown in Figure-1, 2 and Tables I, II, III.

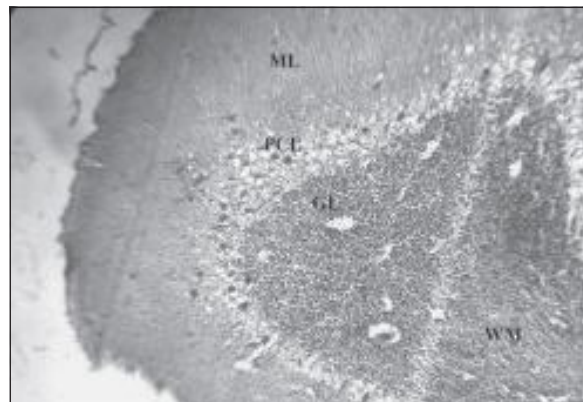


Fig.-1: Photomicrograph of age Group C showing cerebellum. H&E stain: X4 (ML = Molecular Layer, PCL = Purkinje Cell Layer, GL = Granular Layer, WM = White Matter)

Mean thickness of gray matter at foliar summit of cerebellum:

The maximum mean thickness of gray matter at foliar summit was in group A 688.0 µm, B 1363.20 µm and C 1129.60 µm respectively.

The minimum mean thickness of gray matter at foliar summit was in group A 188.8 µm, B 630.4 µm and C 745.6 µm respectively.

The mean (±SD) mean thickness of gray matter at foliar summit was in group A 454 (20±138.85) µm, B 924(18±224.35) µm and C 905(20±117.25) µm respectively (Table-I) and it was also observed that the mean thickness of gray matter at foliar summit increased with age upto certain level then slightly decreased in the late age group C.

The mean thickness of gray matter at foliar summit was maximum in group B (924.18 µm) and was minimum in group A (454.20 µm).

The mean difference of mean thickness of gray matter at foliar summit between groups A&B and groups A&C was statistically highly significant but mean difference between groups B&C statistically was not significant.

Table I (a)

Mean thickness of gray matter at foliar summit among different age groups

Age Group	Number of specimen	Mean thickness (µm) Mean ± SD (Minimum-Maximum)
A (28-42 weeks of gestation)	10	454.20±138.85 (188.80 – 688.0)
B (5 to 30 years)	10	924.18±224.35 (630.40 – 1363.20)
C (31 to 60 years)	10	905.20±117.25 (745.60 – 1129.60)

Table I (b)

Comparison of thickness of gray matter at foliar summit among the age groups

Comparison between Variables	Mean Difference	Std. Error	P significance	Level of significance
A B	469.98	74.55	.000	Highly significant
A C	451.00	74.55	.000	Highly significant
B C	18.98	74.55	.801	Not significant

Mean thickness of gray matter at the depth of fissure of cerebellum:

The maximum mean thickness of gray matter at the depth of fissure was in group A 245.6, B 531.2 and C 496.0 µm respectively.

The minimum mean thickness of gray matter at the depth of fissure was in group A 67.2, B 256.0 and C 265.6 µm respectively.

The mean (±SD) mean thickness of gray matter at the depth of fissure was in group A 185.36±59.01, B 366(64±93.85) and C 343(50±68.90) µm respectively (Figure 2) and it was also observed that the mean thickness of gray matter at the depth of fissure increased with age upto certain level then slightly decreased in the late age group C.

The mean thickness of gray matter at the depth of fissure was maximum in group B (366.64 µm) and was minimum in group A (185.36 µm).

The mean difference of mean thickness of gray matter at the depth of fissure between groups A&B and groups A&C was statistically highly significant but mean difference between groups B&C statistically was not significant.

Table II (a)

Mean thickness of gray matter at foliar summit in both sexes

Age Group	Sex of the person	Number of specimen	Mean thickness (µm)	(±) SE
A(28 to 42 weeks of gestation)	Male	5	433.92	72.22
	Female	5	474.48	57.04
B (5 to 30 years)	Male	5	949.84	125.40
	Female	5	898.52	81.21
C(31 to 60 years)	Male	6	847.47	38.24
	Female	4	991.80	49.89

Table II (b)
Comparison of mean thickness of gray matter at foliar summit in different age group

Age Group	Mean difference between sex	Std. Error difference	t	p	Level of significance
A	40.56	92.03	0.44	.671	Not significant
B	51.32	149.40	0.35	.740	Not significant
C	144.34	61.97	2.33	.048	Significant

Table-II a) and b) depicts that the mean thickness of gray matter at foliar summit was higher in male of group B 949(84±125.40 µm) than that of in female of group B 898(52±81.21 µm) and statistically was not significant, where for group B t = 0.35 and p = .740 but the mean thickness of gray matter at foliar summit was higher in female of group A 474(48±57.04 µm) than that of male of group A 433(92±72.22) and statistically was not significant, where for group A t = 0.44 and p = .671. The mean thickness of gray matter at foliar summit was higher in female of group C 991(80±49.89 µm) than that of male of group C 847(47±38.24) and was statistically significant, where for group C t = 2.33 and p = .048.

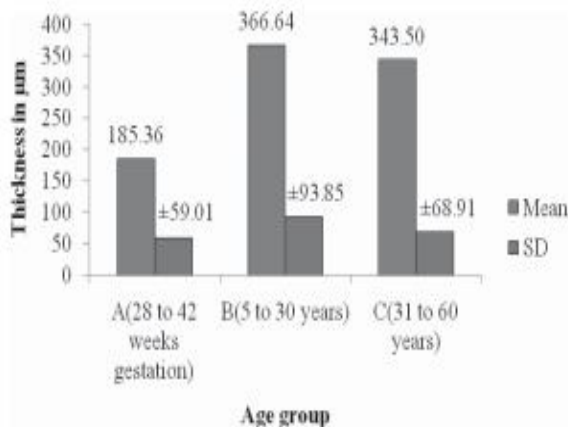


Fig.- 2: Bar diagram showing the mean thickness of gray matter at the depth of fissure in different age groups

Table III (a)
Mean thickness of gray matter at the depth of fissure in both sexes

Age Group	Sex of the person	Number of specimen	Mean thickness (µm)	(±) SE
A(28 to 42 weeks of gestation)	Male	5	176.00	32.17
	Female	5	194.7	22.10
B(5 to 30 years)	Male	5	401.12	28.76
	Female	5	332.16	50.42
C(31 to 60 years)	Male	6	342.94	32.43
	Female	4	344.35	30.52

Table III (b)
Comparison of mean thickness of gray matter at the depth of fissure in different age group

Age Group	Mean difference between sex	Std. Error difference	t3	p	Level of significance
A	18.72	39.03	0.48	.644	Not significant
B	68.96	58.04	1.19	.269	Not significant
C	1.42	47.17	0.03	.977	Not significant

Table-III a) and b) depicts that the mean thickness of gray matter at the depth of fissure was higher in male of group B 401(12±28.76 µm) than that of in female of Group B 332(16±50.42 µm) and statistically was not significant, where for group B t = 1.19 and p = .269 but the mean thickness of gray matter at the depth of fissure was higher in female of group A 194(7±22.10µm) and group C 344(35±30.52) than that of male group A 176(00±32.17) and Group C 342(94±32.43) statistically was not significant, where for group A t = 0.48 and p = .644 and for group C t = 0.03 and p = .977.

Discussion:

Cerebellum enlarges enormously during first year of life then the rate of growth is slow. The increase in volume is partly due to increase in the size and, not in number, of the nerve cells and partly by the growth of the blood vessels, but it is mainly

affected by the progressive myelination of the nerve fibres.⁴

In present study, it was observed that the mean thickness of gray matter at foliar summit increased with age upto certain level then slightly decreased in the late age group. The mean thickness of gray matter at foliar summit was maximum in group B (924.18 μm) and was minimum in group A (454.20 μm).

The mean difference of thickness of gray matter at foliar summit between groups A&B and groups A&C was statistically highly significant but difference between group B&C statistically was not significant.

In the present study it was also observed that the mean thickness of gray matter at foliar summit was higher in female (773.73 μm) than that of male (750.23 μm) but statistically was significant only in group C. This is may be due to faster degeneration of male cerebellar gray matter in old age.

In the present study, it was observed that the mean thickness of gray matter at the depth of fissure increased with age upto certain level then slightly decreased in the late age group. The mean thickness of gray matter at the depth of fissure was maximum in group B (366.64 μm) and was minimum in group A (185.36 μm).

The mean difference of thickness of gray matter at the depth of fissure between groups A&B and groups A&C was statistically highly significant but difference between groups B&C statistically was not significant.

In present study it was also observed that the mean thickness of gray matter at the depth of fissure was higher in male (308.95 μm) than that of female (286.56 μm) but statistically was not significant.

Conclusion:

The result of the present study will enrich the information pool on histomorphology of the cerebellum of Bangladeshi people. To establish a

standard for Bangladeshi people, further study is required by using large number of samples from different parts of Bangladesh.

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