Study of Mean Diameter of Middle Cerebellar Peduncle in Bangladeshi Cadaver.

Haque AQMA[1], Khalil M[2], Sultana SZ[3], Mannan S[4], Rahman MM[5], Hossain M[6], Ara A[7], Begum T[8], Choudhury S[9], Haque N[10]

Abstract

This cross sectional descriptive study was done by using nonprobability sampling technique and performed by examining 63 (sixty three) cerebellum. Out of them 40 postmortem human cerebellum collected from Bangladeshi cadavers of both sexes (male 25 and female 15) age ranging from 5 to 60 years and 23 cerebellums from caesarian section of intrauterine death cases of both sexes (male 14 and female 9) age ranging from 34 wks to 42 wks. of gestation. Specimens were collected from dead bodies autopsied on different dates from April' 2009 to September' 2009 at the autopsy laboratory of department of Forensic Medicine and prenatal cases from Gynaecology and Obstetrics Department of Mymensingh Medical College, Mymensingh. The collected specimens were grouped into three age groups like Group A (28 to 42 weeks of gestation), Group B (5 to 30 years) and Group C (31 to 60 years) and, two sex groups (male and female). The diameters of the middle cerebellar peduncles of both cerebellar hemispheres were measured by using slide calipers and expressed in millimeter (mm). The measurement was taken after fixation into 10% formal saline. The mean (±SD) diameter of right middle cerebellar peduncle was in Group A 6.70±0.95, B 11.57±2.57 and C 11.80±1.40 mm respectively and it was also observed that mean diameter of right middle cerebellar peduncle increased with age. The mean (±SD) diameter of left middle cerebellar peduncle was in Group A 6.44±0.83, B 11.35±2.50 and C 11.40±1.23 mm respectively and it was also observed that mean diameter of left middle cerebellar peduncle increased with age.

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Introduction

The cerebellum is a very important part of central nervous system. It unconsciously controls the smooth contraction of voluntary muscle and carefully coordinates their action.[1] The cerebellum is the portion of brain lying behind and below the cerebrum, it serves to coordinate both voluntary movements and muscle functions in the maintenance of normal posture.[2]

The human cerebellum is an enormously impressive organ.[3] Cerebellum is the largest part of hindbrain, situated in the posterior cranial fossa, behind the pons and the medulla oblongata.[4,5,6,7] 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 criticall

1. * Dr. A.Q.M. Ataul Haque
Associate Professor, Department of Anatomy,
Kumudini Women's Medical College,
Mirzapur, Tangail, Bangladesh,
2. Professor Dr. Mohsin Khalil,
Professor & Head of the Department of Anatomy,
Mymensingh Medical College, Mymensingh, Bangladesh
3. Professor Dr. Seheli Zannat Sultana,
Professor, Department of Anatomy,
Mymensingh Medical College, Mymensingh, Bangladesh
4. Dr. Sabina Mannan,
Associate Professor, Department of Anatomy,
Mymensingh Medical College, Mymensingh, Bangladesh
5. Professor Dr. Md. Mahbubur Rahman,
Professor (C.C), Department of Anatomy,
Community Based Medical College, Bangladesh, Mymensingh
6. Professor Dr. Muazzem Hossain
Professor, Department of Anatomy,
US-Bangla Medical College, Rupganj, Narayanganj, Bangladesh
7. Dr. Anjuman Ara,
Assistant Professor, Department of Anatomy,
Community Based Medical College, Bangladesh,
8. Dr. Taslima Begum,
Associate Professor (C.C), Department of Anatomy,
Pioneer Dental College, Baridhara, Dhaka, Bangladesh
9. Dr. Shilpi Choudhury,
Assistant Professor, Department of Anatomy,
Mymensingh Medical College, Mymensingh, Bangladesh
10. Dr. Nazia Haque,
Assistant Professor (C. C), Department of Microbiology,
Mymensingh Medical College, Mymensingh, Bangladesh

**Address of correspondence*
Email: atauldr@yahoo.com
Mob: + 8801711273335

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 after 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.[7]

Cerebellar cortex consists of three layers – outer molecular, intermediate Purkinje and inner granular.[7] Four pairs of deep cerebellar nuclei in the medullary core of white matter form the output neurons, which are named from medial to lateral side as the nucleus fastigii, nucleus globosus, nucleus emboliformis and nucleus dentatus[7]. These nuclei consist of multipolar neurons and receive axon terminals of Purkinje cells from the cerebellar cortex and collaterals from climbing and mossy fibres. The axons of the deep cerebellar nuclei are projected as the final efferent pathways, through the superior and inferior cerebellar peduncles to the thalamus, red nucleus, brain stem reticular nuclei, inferior olivary and vestibular nuclei. Such output fibres do not provide collaterals to the neurons of the cerebellar cortex. Each dentate nucleus presents a crenated nuclear mass with the hilum directed ventro-medially. It belongs to the neocerebellum and receives projections from the hemispheric or lateral cortex. The axons of dentate nucleus leave through the hilum and the superior cerebellar peduncles and form dentato-rubrothalamic fibres, which decussate in the tegmentum of the lower mid brain and connect with the intermediate (lateral) ventral nucleus.

It contains more nerve cells (neurons) than all the rest of the brain combined, on an average 50 billion neurons.[3,5,7] Purkinje cells form the center of a functional unit of the cerebellar cortex. The total number of neurons in human cerebellum during development decreased significantly from early maturity to old age.[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 diameter of middle cerebellar peduncle 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 diameter of middle cerebellar peduncle to make a standard for Bangladeshi population.

Methods

The study was done by examining 63 (sixty three) cerebellum out of them 40 postmortem human cerebellum collected from Bangladeshi cadavers of both sexes (male 25 and female 15) age ranging from 5 to 60 years and 23 cerebellums from caesarian section of dead fetuses of both sexes (male 14 and female 9) age ranging from 34 wks to 42 wks. of gestation. 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. All the collected specimens of postnatal cases were from medico-legal cases (suicidal, homicidal, or accidental death) and the specimen of foetus from intra-uterine death cases (eclampsia, ante-partum haemorrhage, obstructed labour). Grossly injured cases involving head-neck region and cerebellum of decomposed bodies were excluded. The specimen was labeled with a specimen number, recording age and sex of the cadaver

and then fixed in 10% formal solution, by floating freely in a suitable container with a lid. The specimen was allowed to fix for a period of one or two weeks. The present study was done with these fixed specimens in spite of some hardening and shrinking of tissue brought about by fixation. These could not be avoided at the brains, because in fresh state, they were too soft to handle. It took one to two weeks for them to get sufficiently hard to allow normal handling and dissection to be carried out. The collected sample was grouped into three age groups like Group A (34 to 42 weeks of gestation), Group B (5 to 30 years) and Group C (31 to 60 years). The measurement was taken after fixation into 10% formol saline. The diameters of the middle cerebellar peduncles of both cerebellar hemispheres were measured by using slide calipers and expressed in millimeter (mm). Mean values were put down in a tabulated form for convenient 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.

Result

Mean Diameter of middle cerebellar peduncle (both right & left)

The maximum mean diameter of right middle cerebellar peduncle was in Group A 8.5, B 16.0 and C 14.5 mm respectively.
The minimum mean diameter of right middle cerebellar peduncle was in Group A 5.5, B 6.5 and C 10.0 mm respectively.

The mean (±SD) diameter of right middle cerebellar peduncle was in Group A 6.70±0.95, B 11.57±2.57 and C 11.80±1.40 mm respectively (Table-I, figure -1) and it was also observed that mean diameter of right middle cerebellar peduncle increased with age.

The mean diameter of right middle cerebellar peduncle was maximum in Group C (11.80 mm) and was minimum in Group A (6.70 mm).

The mean difference of mean diameter of right middle cerebellar peduncle between Groups A&B and A&C was statistically highly significant but mean differences between Group B&C statistically was not significant.

Mean Diameter of left middle cerebellar peduncle
The maximum mean diameter of left middle cerebellar peduncle was in Group A 8.0, B 16.0 and C 14.0 mm respectively.

The minimum mean diameter of left middle cerebellar peduncle was mm in Group A 5.0, B 6.0 and C 9.0 respectively.

The mean (±SD) diameter of left middle cerebellar peduncle was in Group A 6.44±0.83, B 11.35±2.50 and C 11.40±1.23 mm respectively (Table-III, figure 2) and it was also observed that mean diameter of left middle cerebellar peduncle increased with age.

The mean diameter of left middle cerebellar peduncle was maximum in Group C (11.40 mm) and was minimum in Group A (6.44 mm).

The mean difference of diameter of left middle cerebellar peduncle between Groups A&B and A&C was statistically highly significant but mean differences between Group B&C was statistically not significant.

Table-I: Mean Diameter of the Right Middle Cerebellar Peduncle in Different Age Groups

Age Group	Number of specimen	Diameter (mm) Mean ± SD (Minimum – Maximum)
A (28-42 weeks of gestation)	23	6.70 ± 0.95 (5.5 – 8.5)
B (Upto 30 years) B (Upto 30 years)	23	11.57 ± 2.57 (6.5 – 16.0)
C (31 to 60 years)	17	11.80 ± 1.40 (10.0 – 14.5)

Comparison of mean diameter of right middle cerebellar peduncle among the age Groups

Table-II: Mean Diameter of Right Middle Cerebellar Peduncle between Both Sexes

Sex	Number of specimen	Mean diameter in mm	(±) SE
Male	39	9.74	0.49
Female	24	0.05	0.60

Comparison of mean diameter of right middle cerebellar peduncle between both sexes

Relatio between Variables		Mean Difference	(±SE)	P	Level of significance
A	B	4.87	0.54	.000	Highly Significant
A	C	5.10	0.58	.000	Highly significant
B	C	0.23	0.58	.693	Not significant

Mean difference	Std. Error difference	t value	p value	Level of significance
0.31	0.79	0.40	.693	Not significant

Table-II depicts that the mean diameter of right middle cerebellar peduncle was higher in female (10.05 ± 0.60 mm) than that of in male (9.74 ± 0.49 mm) but statistically was not significant, where t = 0.40 and p = 0.693.

Table-III: Mean Diameter of the Left Middle Cerebellar Peduncle in Different Age Groups

Age Group	Number of specimen	Diameter (mm) Mean ± SD (Minimum – Maximum)
A (28-42 weeks of gestation)	23	23 6.44 ± 0.83 (5.0 – 8.0)
B (Upto 30 years)	23	11.35 ± 2.50 (6.0 – 16.0)
C (31 to 60 years)	17	11.40 ± 1.23 (9.3 – 14.0)

Comparison of mean diameter of left middle cerebellar peduncle among the age Groups

Table-IV: Mean Diameter of Left Middle Cerebellar Peduncle between Both Sexes

Sex	Number of specimen	Mean diameter in mm	(±) SE
Male	39	9.46	0.47
Female	24	9.75	0.62

Comparison of mean diameter of right middle cerebellar peduncle between both sexes

Mean difference	Std. Error difference	t value	p value	Level of significance
0.30	0.77	0.39	.699	Not significant

Table-IV depicts that the mean diameter of left middle cerebellar peduncle was higher in female (9.75 ± 0.62 mm) than that of in male (9.46 ± 0.47 mm) but statistically was not significant, where t = 0.39 and p = 0.699.

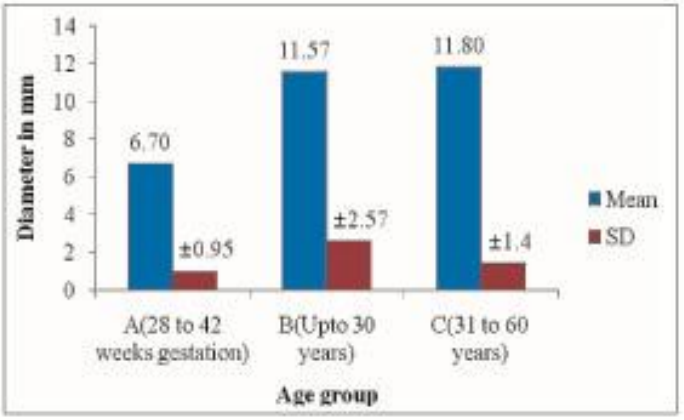

Figure-1: Bar diagram showing the mean diameter of right middle cerebellar peduncle in different age Groups

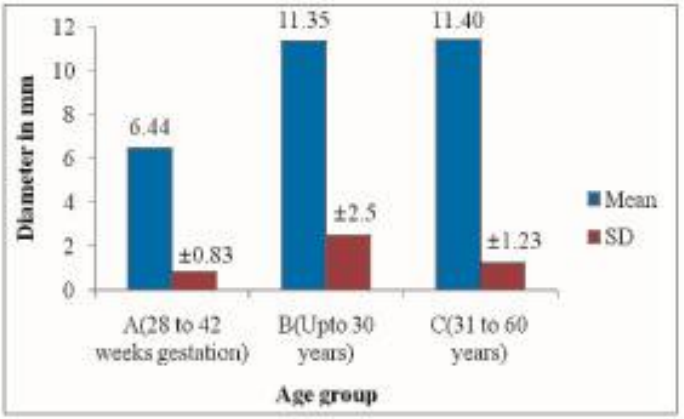

Figure 2: Bar diagram showing the diameter of left middle cerebellar peduncle in different age Groups

Table-V: Mean Diameter of Middle Cerebellar Peduncle of Right and Left Side

Side	Number of specimen	Mean diameter in mm	(±) SE
Right	63	9.85	0.38
Left	63	9.57	0.37

Comparison of mean diameter of middle cerebellar peduncle between right and left side

Mean difference	Std. Error difference	t value	p value	Level of significance
0.29	0.53	0.54	.593	Not significant

Table-V : depicts that the mean diameter of the middle cerebellar peduncle was higher on right side (9.85 ± 0.38 cm) than that of on left side (9.57 ± 0.37 mm) but statistically was not significant, where t = 0.54 and p = 0.593.

Discussion

Diameter of middle cerebellar peduncle

Diameter of right middle cerebellar peduncle

In present study, it was found that the mean (±SD) diameter of right middle cerebellar peduncle was in Group A (28 to 42 weeks of gestation) 6.70±0.95, B (upto 30 years) 11.57±2.57 and C (31 to 60 years) 11.80±1.40 mm respectively.

The mean diameter of middle cerebellar peduncle was described by Nicoletti et al (2006) was 9.80 ± 0.66 mm but they did not mention the age, sex and side of the study population[9]. This value is much higher than the value of Group A but lower than the value of Group B and C. But it is similar to mean diameters of all age groups. The mean diameter of middle cerebellar peduncles was 9.85 mm on right side and 9.57 mm on left side.

The mean diameter of right middle cerebellar peduncle was maximum in Group C and minimum in Group A. It was also observed that the mean diameter of right middle cerebellar peduncle was increased with age .Mean differences of diameter statistically was highly significant between Group A&B and A&C but insignificant between Group B&C.

Szabó et al (2003) observed that there were no significant differences between cerebellar volumes regarding handedness or sex[10]. In the present study it was found that the mean diameter of right middle cerebellar peduncle was higher in female than that of in male but statistically was not significant.

Diameter of left middle cerebellar peduncle

In present study, it was found that the mean (±SD) diameter of left middle cerebellar peduncle was, and in Group A (28 to 42 weeks of gestation) 6.44±0.83, B (upto 30 years) 11.35±2.50 and C (31 to 60 years) 11.40±1.23 mm respectively.

The mean diameter of middle cerebellar peduncle was described by Nicoletti et al (2006) was 9.80 ± 0.66 mm but they did not mention the age, sex and side of the study population[9]. This value is much higher than the value of Group A but lower than the value of Group B and C. But it is similar to mean diameters of all age Groups. The mean diameter of middle cerebellar peduncles was 9.85 mm on right side and 9.57 mm on left side.

The mean diameter of left middle cerebellar peduncle was maximum in Group C and that the mean diameter of left middle cerebellar peduncle was increased with age. Mean differences of diameter statistically was highly significant between Groups A&B and Groups A&C but insignificant between Groups B&C.

Szabó et al (2003) observed that there were no significant differences between cerebellar volumes regarding handedness or sex[10]. In the present study it was found that the mean diameter of left middle cerebellar peduncle was higher in female than that of in male but statistically was not significant.

minimum in Group A. It was also observed It was also observed in present studies that mean diameter of right middle cerebellar peduncle was higher than that of mean diameter of left middle cerebellar peduncle but statistically was not significant.

The mean diameter of the middle cerebellar peduncle was higher on right side (9.85 ± 0.38 cm) than that of on left side (9.57 ± 0.37 mm) but statistically was not significant, where t = 0.54 and p = 0.593.

Conclusion

The result of the present study will enrich the information pool on diameter of superior cerebellar peduncle 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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