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Original Research Paper

Anatomy

SEXUAL DIMORPHISM IN CORPUS CALLOSUM

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ABSTRACT

INTRODUCTION: The shape and size of corpus callosum varies according to gender, age and races. Therefore, morphometric measurements are necessary to calculate normative value for a comparative study.

METHODS: The quantitative MRI study reports measurements of corpus callosum taken from mid-sagittal brain images in 50 men and 50 women.

RESULTS: The mean length of corpus callosum in males was 7.27cm and females was 6.93cm. The mean height of corpus callosum in males was 2.56cm and in females was 2.31cm. Thickness of body at midpoint was 0.65cm in males and 0.60cm in females.

CONCLUSIONS: The Length of corpus callosum (Lc), minimum thickness(Tmi), thickness of rostrum(Tr), thickness of splenium(Ts) were significantly greater in males. The distances genu to Fornix Length(G-F), Genu to Anterior Commissure Length(G-C), Shortest distance of anteriormost point of corpus callosum to cortical surface(A-S), Shortest distance of posterior most point of corpus callosum to cortical surface(P-S), Length of brain(LB), distance of occipital pole to posteriormost point of corpus callosum(O-P) were also significantly greater in males.

KEYWORDS : Corpus callosum, MRI, Sexual Dimorphism.

INTRODUCTION:

Corpus callosum represents the major cerebral commissure connecting the homotropic and heterotopic cortical regions of both hemispheres.[1,2] Corpus callosum is of interest not only because of its key role in normative processes of hemispheric communication and specialization[3] but also because of its vulnerability to white matter diseases like multiple sclerosis[4] and toxins like alcohol[5-7] . Lesions of corpus callosum are accompanied by apraxia[8] , diminished temporal[9,10] and spatial[11-13]coordination of bimanual movements.

Sexual dimorphism of corpus callosum has been a debatable topic in literature. Several studies have mentioned significant difference in length and shape of corpus callosum in males and females while others have condemned it [14-17]. MRI is the latest form of brain imaging that can provide the slice images of the brain in any plane using non-ionising energy. Contrast between white and gray matter on MRI enables one to identify all discrete nuclear structures and lesions[18].MRI typically uses a single midsagittal slice and different approaches to measure area, shape and defining different subregions of corpus callosum. Accurate measurements of size and subregions of corpus callosum in healthy adult individuals of either sex can help us to estimate the sexual differences and provide the norms against which any deviation to normal can be compared.

Many such studies have been conducted in Caucasian population, but we came across few such studies in India viz on preserved brains by Banka et al(1996), on MRI scans by Suganthy et al(2003), including both MRI and preserved brains by Gupta T et al(2009) and on MRI by Gupta T et al. Hence the purpose of this study is to observe the sexual dimorphism in individuals between 20-60years in our country.

AIMS AND OBJECTIVES

To compare morphometric parameters of corpus callosum in healthy individual of either sex on MRI between age group 20-60 years.

MATERIALS AND METHODS

This study was carried out in the Department of Anatomy and Radiology at Dr.RKGMC Hamirpur, Himachal Pradesh. Total of 100 healthy individuals (50 females and 50 males) aged between 20-60 years who consented to the study were included in the study and MRI of the brain was done. Midsagittal section of MRI brain showing corpus callosum was subjected to analysis.

THE FOLLOWING MORPHOMETRIC MEASUREMENTS WERE DONE:(Fig 1-4)

1. Length of corpus callosum (Lc).
2. Thickness of body of corpus callosum at mid point (T).
3. Maximum thickness of rostrum (Tr).
4. Maximum thickness of splenium (Ts).
5. Height of corpus callosum (Hc)
6. Maximum and minimum thickness of body of corpus callosum (Tmax and Tmi).
7. Maximum thickness of anterior half of corpus callosum body (TBA).
8. Maximum thickness of posterior half of corpus callosum body (TBP).
9. Genu-Fornix Length (G-F).
10. Genu-Anterior Commisure Length (G-C).
11. Shortest distance from anterior most point of corpus callosum to cortical surface (A-S)
12. Shortest distance from top most point of corpus callosum to cortical surface (T-S).
13. Shortest distance from posterior most point of corpus callosum to cortical surface (P-S).
14. Length of brain (LB): From frontal pole to occipital pole of brain in midsagittal section.
15. Distance from frontal pole of brain to anterior most point of corpus callosum (F-A).
16. Distance from occipital pole of brain to posterior most point of corpus callosum (O-P).

FOLLOWING RATIOS WERE CALCULATED:

1. Length of corpus callosum /Length of brain (Lc/LB).
2. Splenial Thickness /Length of corpus callosum (Ts/Lc).
3. Splenial Thickness /Length of brain(Ts/LB).
4. Thickness of body at mid point/Length of corpus callosum (T/Lc).
5. Thickness of body at mid point/Height of corpus callosum (T/Hc).

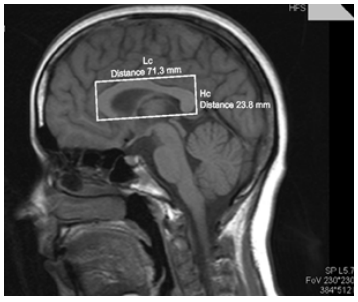

Fig.1:MEASURMENT CALLOSUM (MIDSAGITTAL MRI)

Fig. 2: MEASURMENT OF CORPUS CALLOSUM (MIDSAG ITTAL MRI)

A-S: Shortest distance from anterior most point of corpus callosum to cortical surface

F-A: Distance from frontal pole of brain to anterior most point of corpus callosum

T-S: Shortest distance from top most point of corpus callosum to cortical surface

Tmi:Minimum thickness of body of corpus callosum

P-S: Shortest distance from posterior most point of corpus callosum to cortical surface

O-P: Distance from occipital pole of brain to posterior most point of corpus callosum

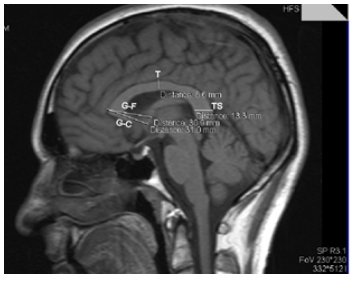

Fig. 3: MEASURMENT OF CORPUS CALLOSUM (MIDSA GIT TAL MRI)

G-F: Genu-Fornix Length

G-C: Genu-Anterior Commisure Length

T: Thickness of body of corpus callosum at mid point

Ts: Maximum thickness of splenium

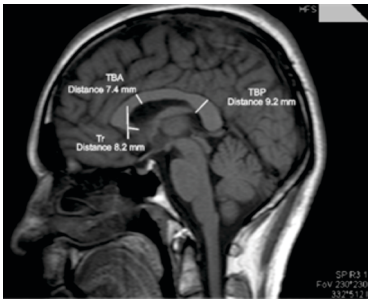

Fig. 4: MEASURMENT OF CORPUS CALLOSUM (MIDSAG ITTAL MRI)

TBA: Maximum thickness of anterior half of corpus callosum body

Tr: Maximum thickness of rostrum

TBP: Maximum thickness of posterior half of corpus callosum body

STATISTICAL ANALYSIS

The statistical analysis was carried out using unpaired T-Test for results comparison between corpus callosum of males and females.

RESULTS

CC PARAMETER	MALE MEAN	MALE STD DEV	FEMALE MEAN	FEMALE STD DEV	P VALUE
Lc	7.2796	0.604277	6.9392	0.392089	.001**
Hc	2.5608	0.641261	2.3168	0.607086	.054
T	0.6516	0.152869	0.6088	0.132859	.138
Tmax	0.8412	0.153552	0.8256	0.170679	.632
Tmi	0.481	0.103278	0.4374	0.098723	.033*
Tr	1.1262	0.229764	1.0076	0.133333	.002*
Ts	1.139	0.193573	1.059	0.186046	.038*
TBA	0.7514	0.152891	0.803	0.228091	.187
TBP	0.7694	0.18246	0.7092	0.186404	.106
G-F	2.7528	0.461289	2.4232	0.32583	.001**
G-C	2.8176	0.302031	2.6464	0.274589	.004**
A-S	3.4358	0.31963	3.2528	0.343416	.007**
P-S	4.498	0.533096	4.3002	0.412748	.041*
T-S	3.6476	0.449015	3.6588	0.406471	.896
LB	15.9424	1.040562	15.2366	0.517559	.001**
F-A	3.580417	0.481703	3.424	0.318914	.060
O-P	5.742292	0.615924	5.31	0.494835	.001**
Lc/LB	0.457256	0.034547	0.455788	0.027681	.815
Ts/Lc	0.156931	0.027308	0.152535	0.0246	.400
Ts/LB	0.071653	0.012508	0.069584	0.012469	.410
T/Lc	.090124	0.022792	0.087836	0.019017	.587
T/Hc	0.266572	0.082574	0.273197	0.069187	.665

1. Lc, Tmi, Tr, Ts, G-F, G-C, A-S, P-S, LB, O-P were signifi cantly greater in males with a 'p'value of <0.05 (fig.5)
2. Hc, T, Tmax, TBP, F-A were more in males, while TBA, T-S were more in females although statistically non-significant.

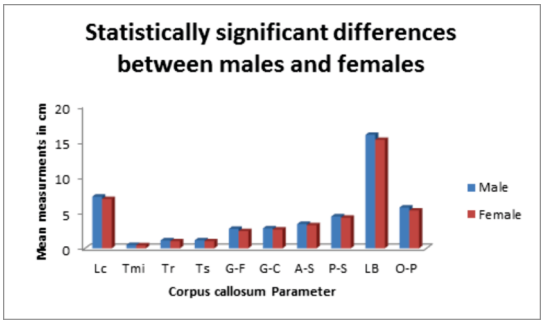

Fig.5: STATISTICALLY SIGNIFICANT DIFFERENCES BETWEEN MALES AND FEMALES

DISCUSSION

The results from this study show that morphometric differences do exist in anatomy of corpus callosum between males and females aged 20-60years. These morphometric parameters may be taken as standards to find any deviation from normal. In the present study sexual dimorphism was observed in the following parameters:-

1. Larger Lc in males compared to females ('p' value 0.001).Same results were also reported by Gupta T et al[19], Suganthy et al [14] and Elster et al[20].
2. Distance between Genu and Fornix (G-F), occipital pole to posteriormost point of corpus callosum (O-P) were same as in accordance with the study conducted by Gupta T[19].
3. Length of brain were significantly greater in males ('p' value 0.001) as compared to females as also reported by Gupta T[19].

4. No significant differences('>p' value 0.005) in splenial thickness of either sex were found in this study unlike that reported by Bishop & Wahlstein[21], Luders et al [22],Witelson[23], Suganthy et al and Banka et al[24] where significant difference was found.

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