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Magnetic Resonance Measurement of Lateral Ventricular Diameters in Cases of Colpocephaly and Corpus Callosum Agenesis

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Abstract

Objective: One of the most typical brain anomalies seen in humans is agenesis of the corpus callosum. Its estimated prevalence in the general population is 3-7 per 1000. Apart from the absence of the corpus callosum, one of the most common symptoms is colpocephaly. In this study, we aimed to measure the lateral ventricle diameters by magnetic resonance imaging in cases of colpocephaly secondary to corpus callosum agenesis.

Methods: Patients diagnosed with colpocephaly secondary to corpus callosum agenesis between January 2005 and December 2021 were re-evaluated in retrospective scans. The patients' age, gender, and their measurement values in the magnetic resonance examination were noted.

Results: The study was carried out with 90 patients who met the criteria. It was found that if the occipital horn of the lateral ventricle is over 20 mm and the other horns are smaller than 7 mm, it can predict the presence of colpocephaly with a sensitivity of 94% and a specificity of 95% (area under the curve = 0.728).

Keywords: Agenesis, corpus callosum, lateral ventricle

INTRODUCTION

The band of over 200 million nerve fibers known as the corpus callosum joins the left and right cerebral hemispheres. The rostrum, genu, anterior midbody, isthmus, and splenium have historically been considered to comprise the corpus callosum's 5 different components. The main function of the corpus callosum is to allow interhemispheric transmission utilizing both inhibitory and excitory mechanisms.[1] It begins to mature through a difficult process of neuronal migration and development around the 12th week of pregnancy. By week 20, fetal magnetic resonance imaging (MRI) or an ultrasound examination can detect the corpus callosum. As with most brain structures, the corpus callosum is thought to be fully developed at age 4, but it probably continues to evolve over the years.[2,3] Agenesis of the corpus callosum (CCA) is one of the most frequent brain abnormalities seen in humans. Its prevalence is estimated to range from 3 to 7 per 1000 live births in the general population, depending on diagnostic methods and sample groups. Colpocephaly is one of the indispensable criteria in CCA.[4] Although there are many studies measuring lateral ventricular diameters in the literature, there is no measurement in cases of corpus callosum and colpocephaly. In this study, we aimed to measure the lateral ventricle diameters in adult patients with corpus callosum agenesis and colpocephaly.

METHODS

The Institutional Review Board gave its approval for this retrospective investigation. Because this was a retrospective study, informed consent was not required (ethics committee number: 43576249-502.01.02-E.40336, date: July 10, 2022, Erzincan Binali Yıldırım University).

Between January 2005 and December 2021, the hospital medical archive was retrospectively scanned for the words “colpocephaly” and “corpus callosum agenesis.” Patients younger than 18 years of age were excluded from the study, but no other exclusion criteria were applied. Measurements were carried out in the 1.5 T magnetic resonance (MR) system (Magnetom Aera, Siemens Healthcare, Erlanger, Germany) cranial MR examination using standard T2 axial images (slice thickness is 5 mm, FoV read is 220 mm, FoV phase is 100%, voxel size:0.7 × 0.7 × 5 mm dist factor is 20%, the repetition time 5600 ms and time of echo 103 ms, and averages are 1). While the measurements in the frontal and temporal horns were made 5 mm deep at the farthest distance, the measurements in the occipital horns were made from the widest part. Measurements were made only in axial sections in the transverse plane. Examples of measurements taken are schematized in Figures 1-3.

The instrument used to analyze the study's data was the Statistical Package for the Social Sciences (SPSS) for Windows 20 (IBM SPSS Inc., Chicago, Ill, USA). The normal distribution of the data was confirmed by the Kolmogorov–Smirnov test. The mean and standard deviation of numerical data with a normally distributed distribution are shown. Data that do not have a normal distribution are shown using the median. The Mann–Whitney *U* test and the Student's *t*-test were used to compare numerical variables between groups. Pearson and Spearman correlation analyses were used to look for any relationships between the variables. Positive predictive value, negative predictive value, and receiver operating

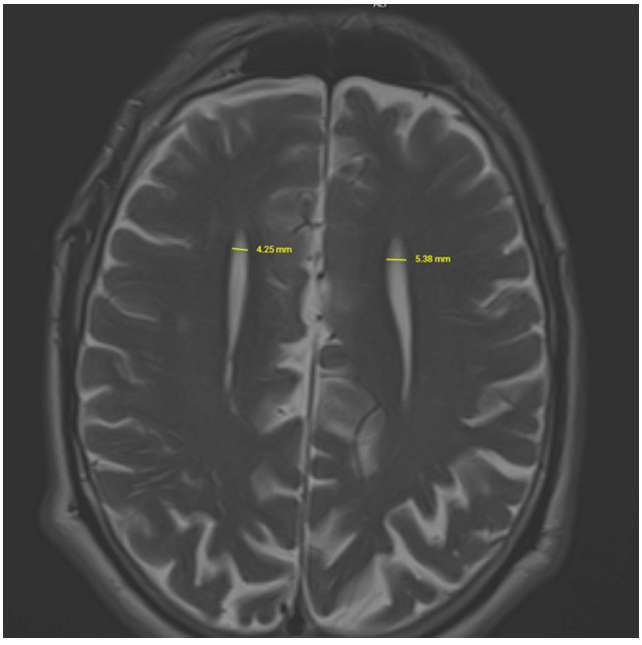

Figure 1. The measurement of the frontal horns of the lateral ventricles in a 40-year-old male patient with colpocephaly and agenesis of the corpus callosum is schematized. The measurements were 4.25 mm on the right and 5.38 on the left in both lateral ventricles.

characteristic (ROC) analyses were used to assess the effectiveness of the investigated diagnostic techniques. $P = .05$ was considered as the statistically significant value.

RESULTS

About 108 patients who met the criteria were found, and since the images of 18 of them could not be accessed, 90 patients remained. The mean age was calculated as 40 (range: 18-64 years). Fifty of the patients (55%) were men and 40 were women (45%). In cases with corpus callosum, no significant difference was observed between the 2 groups in terms of gender ($P > .05$). The lateral ventricle frontal horn diameters were 5.10 mm, the occipital horn diameters were 19 mm, and the temporal horn was 5.5 mm (5.10 ± 2.5 mm, 19 ± 5.5 mm, 5.5 ± 2.2 mm, respectively). There was no significant difference between the cases in terms of right or left comparison ($P > .05$). As a requirement of colpocephaly, occipital horns were found to be significantly higher than frontal and temporal horns (19 ± 5.5 mm vs. 5.10 ± 2.5 mm and 5.5 ± 2.2 mm, $P < .01$) (Table 1). It was found that if the occipital horn of the lateral ventricle is over 20 mm and the other horns are smaller than 7 mm, it can predict the presence of colpocephaly with a sensitivity of 94% and a specificity of 95% (area under the curve = 0.728).

MAIN POINTS

- Recognizing the lateral ventricle diameters in cases of colpocephaly facilitates diagnosis.The most important radiological finding in cases with colpocephaly is the occipital horn of the lateral ventricle greater than 20 mm. Another supporting finding in the diagnosis is the other segment measurements of the lateral ventricle less than 7 mm.
- Although the sample size of our study was not sufficient, it was larger than other similar studies.In addition, only the pediatric age group should be included in the study, which should be our goal in the next study.

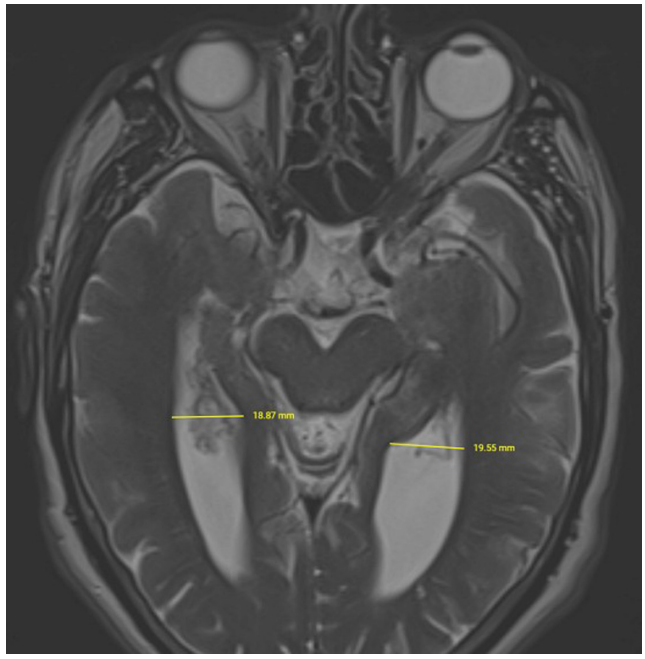

Figure 2. The measurement of the occipital horns of the lateral ventricles in a 40-year-old male patient with colpocephaly and agenesis of the corpus callosum is schematized. The measurements were 18.87 mm on the right and 19.55 on the left in both lateral ventricles.

DISCUSSION

There are just 2 other adult cases reported in medical literature, making colpocephaly a diagnosis that is well accepted in pediatrics. Benda originally identified it as a congenital type of ventriculomegaly in 1941. There were relatively few occurrences of colpocephaly that were discovered in adults, according to Srivastava et al. Esenwa and Leaf[5]

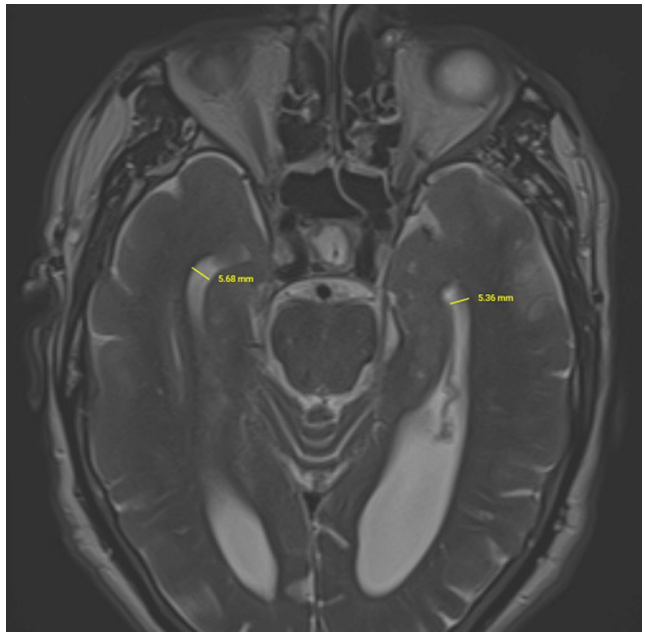

Figure 3. The measurement of the temporal horns of the lateral ventricles in a 40-year-old male patient with colpocephaly and agenesis of the corpus callosum is schematized. The measurements were 5.68 mm on the right and 5.36 on the left in both lateral ventricles.

Table 1. Diagnostic Sensitivity of LV Segment Measurements in Patients with Colpocephaly

LV Segment	Mean Diameter(mm)	*P*
LV frontal horn	5.10	>.05
LV temporal horn	5.50	>.05
LV occipital horn	19	<.05

LV, lateral ventricle.

described an adult patient who experienced symptoms all of her life. Asymptomatic cases of corpus callosum agenesis or dysgenesis may be diagnosed early or discovered incidentally in obstetric ultrasound scans. A rapid increase in head size due to postpartum hydrocephalus, signs of tense fontanelles, vomiting, decreased sucking, and signs of epileptic seizures may occur in severe cases.[1]

Numerous congenital insults can cause colpocephaly. It has been suggested that chromosomal anomalies, maternal toxin exposure, anoxic encephalopathy, and prenatal infections—anomalies such toxoplasmosis—are possible causes. The fetus has a stage of relative hydrocephalus just before the fifth month of life, which is typically reversed by the expansion of the surrounding white matter and corpus callosum, glial cell migration, and glioma.[6] The retained fetal ventricular shape that characterizes colpocephaly may be brought on by any intrauterine injury that hinders this maturation process.[7]

There are few studies in the literature that include occipitofrontal ratio measurement. Esenwa and Leaf[5] stated that if this ratio is above 3, it suggests colpocephaly. However, there are no studies measuring lateral ventricular diameters and normal ranges in cases of colpocephaly. In our study, the diameters of colpocephaly were measured as 5.1 mm in the frontal horn, 19 mm in the occipital horn, and 5.5 mm in the temporal horn. In this sense, it is the first study to give the mean diameters of colpocephaly. As it is known in colpocephaly, there is an increase in the occipitofrontal ratio in the lateral ventricle. In this sense, in our study, if the lateral ventricle occipital horn is larger than 20 mm and the other horns are smaller than 7 mm, it predicts colopocephaly with high sensitivity and specificity.

Adult patients were included in our study. Therefore, it is incompatible with pediatric measurements. It is recommended to determine the measurements with new studies that include pediatric subgroups in the future. Although occipitofrontal ratio measurements are available in the adult groups, they are not available in the literature in the pediatric group. Evaluation of proportional measurements together with lateral ventricular measurements in pediatric patients will increase the diagnostic quality.

There are many volumetric measurements for the lateral ventricle in the literature. However, the inclusion of volumetric measurements in cases of colpocephaly and CCA will facilitate the diagnosis in the future.

About 90 patients were included in the study, which is not sufficient. For this reason, studies with a larger population will increase reliability. Atrophic changes were not taken into account in our study. For this reason, there may have been misleading findings in the measurements. Re-evaluation with new studies and subgroups including the degree of atrophy in the future may provide high diagnostic power. The lack of proportional measurements of the lateral ventricles and the lack of volumetric calculations also reduced the diagnostic quality of our study. In addition, not using the data in tabular form in our study may cause difficulties in concentrating the attention of the readers.

Knowing the lateral ventricle diameters and using frontal and occipital threshold values together facilitate the diagnosis in cases of colpocephaly developing secondary to the corpus callosum.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Erzincan Binali Yıldırım University (Date: July 10, 2022, Decision No: 43576249-502.01.02-E.40336).

Informed Consent: Because this is a retrospective study, the required consent documents were not obtained.

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Declaration of Interests: The authors declare that they have no conflicts ofinterest.

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CONCLUSION

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