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Morphometric Characteristics of the Brain Ventricular System Based on the Magnetic Resonance Imaging Data

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In this study there are presented the results of a morphometric description of brain ventricle sizes based on the data collected via the magnetic resonance imaging in 60 men and 60 women of early adulthood. Study includes the magnetic resonance imaging scans of the heads of people who were specifically proven not to have any cerebral pathology. There were studied the linear sizes of the liquor system objects, the comparison of those parameters in men and women was carried out as well. For those objects that have a chiral symmetry, the bilateral differences were also determined.

Key words: magnetic resonance imaging, brain ventricles, early adulthood, bilateral symmetry, gender differences.

Introduction

Magnetic resonance imaging (MRI) is one of the new methods that provides the imaging that is used in medicine. In its physical and technical basis it is drastically different from the other methods used up to this day. It is based on the combined use of the magnetic field and radiofrequent impulses. MRI and its modifications allow to collect valuable data about anatomical systems and organs in vivo. The ways that the MRI may be used in anatomy are: a) anatomical interpretation of the MRI scans in preparation of cadaver slices in the dimensions, examined by the MRI; b) using the MRI scans as the source of the anatomical information, thus when determining a diagnosis the clinicist should compare the image of the pathological object to that of a normal one. Thus, one of the goals of modern human anatomy is to determine the quantitative and qualitative characteristics of various organs in vivo via the MRI in order to form a system of traits that characterize a normal live human organ.

Magnetic resonance imaging is a highly informative method when observing organs with a high water content. One of the most commonly studied objects is the central nervous system. MRI can be used to observe almost any part of the brain [2, 3]. Almost all parts of the brain relief can be seen. Individual and age-related features of the fissures and the gyri can be defined as well as the ratio between grey and white matter on different levels. Due to the high intensity of the signal sent by the cerebrospinal fluid, the ventricular system of the brain can be clearly visualized.

Materials and Methods

The goal of this study was to observe the morphometric characteristics of the ventricular system of the brain in patients of the early adulthood via the MRI. This research was carried out on the magnetic resonance images from a private archive. 120 images were studied (T1 and T2) in 60 men and 60 women aged 25. The application of the morphometric techniques followed the recommendations of the encephalometrics guidelines [1].

Results and Discussion

In men the length of the anterior horn of the right lateral ventricle (LV) is 29.3 ± 2.74 mm, of the left – 28.6 ± 2.78 mm. In women the length of the anterior horn of the right LV is 27.4 ± 2.73 mm, the left one – 26.3 ± 2.52 mm, which is 4.18% less, than that of a right LV ($p < 0.05$). Thus, the length of the anterior horn of the right and the left LV of men is respectively 6.93% and 8.47% more than that of women ($p < 0.05$).

The width of the anterior horn of the LV of the right hemisphere in men equals 7.8 ± 1.69 mm, in the left hemisphere – 7.2 ± 1.14 mm. Gender and interhemispheric variability has not been determined.

The length of the central part of the LV in the right hemisphere of men equals 38.8 ± 5.14 mm, in the left hemisphere – 39.4 ± 6.37 mm. In women the length of the central part of the right LV equals 41.4 ± 6.93 mm, the left LV – 42.4 ± 4.85 mm. Interhemispheric asymmetry was not present, although, the length of the central part of the left LV of women is 7.61% higher than that of men ($p < 0.05$).

The width of the central part of the right LV in men is 11.3 ± 2.64 mm, in women – 11.1 ± 1.94 mm. The width of the central part of the left LV in men equals 10.8 ± 2.53 mm, in women – 11.2 ± 2.20 mm. Gender and interhemispheric variability hasn't been statistically determined.

The length of the posterior horn of the right LV in men was 34.8±8.49 mm, the left LV – 33.8 ± 6.97 mm. In women there was noted an interhemispheric asymmetry: the length of the left posterior horn is 25.5 ± 8.87 mm, the right one – 27.3 ± 9.17 mm, which is higher by 7.06% ($p < 0.05$). Gender variability presents: the length of the right and left posterior horns of men is higher by 27.47% and 32.55% respectively than those of the posterior LV horns of women ($p < 0.05$).

The width of the posterior LV horn in the right hemisphere in men equals 10.4 ± 2.23 mm, in women – 9.6 ± 1.87 mm; in the left hemisphere of men – 9.9 ± 1.86 mm, of women – 8.7 ± 2.18 mm. Interhemispherical variability was not noted among men, although in women the size of the right posterior horn is 10.34% more than that of the left. Also the length of the left posterior horn of the LV in men is 13.79% is higher than that of women ($p < 0.05$).

In men the length of the inferior horn of the LV in the right hemisphere is 45.3 ± 6.34 mm, in the left hemisphere – 47.8 ± 5.27 mm, which is 5.52% higher ($p < 0.05$). In

women the length of the inferior horn of the right hemisphere is 44.7 ± 4.87 mm, in the left hemisphere – 46.5 ± 4.73 mm. Gender differences were not noted.

The anteroposterior size of the right LV of men equals 89.4 ± 10.9 mm, of women – 84.5 ± 10.00 mm. The anteroposterior size of the left ventricle of men equals 88.3 ± 11.2 mm, of women – 81.7 ± 10.11 mm. Thus, in women the anteroposterior size of the right ventricle is 3.48% bigger than that of the left ventricle ($p < 0.05$). In men the anteroposterior size of the right ventricle is 8.08% bigger than that of the left ventricle ($p < 0.05$).

The distance between the anterior horns of the LV equals in men – 33.2 ± 2.51 mm, in women – 32.1 ± 3.23 mm.

The distance between the posterior horns of the LV is: in men – 47.6 ± 8.80 mm, in women – 45.4 ± 9.82 mm.

The length of the III ventricle in men equals 32.7 ± 3.68 mm, and in women – 28.6 ± 2.75 mm which is less than that of the men by 14.33% ($p < 0.05$).

The height of the III ventricle is also 13.70% higher in men than in women: in men – 24.9±2.78 mm, in women – 21.9 ± 3.54 mm ($p < 0.05$).

The width of the III ventricle in men equals 4.6 ± 0.17 mm, in women – 4.6 ± 0.18 mm.

The length of the aqueduct in men is 14.4 ± 2.00 mm, in women – 13.8 ± 1.64 mm.

The sizes of the IV ventricle also had no gender features. The length of the IV ventricle in men equals 44.3 ± 5.60 mm, in women – 44.4 ± 4.21 mm. The height of the IV ventricle in men is 11.8 ± 2.03 mm, in women – 11.2 ± 1.87 mm.

Thus, this study has determined the morphometric parameters of the brain ventricles in a live human. It has shown the morphometric criteria of the gender and interhemispheric variability of the ventricular system of the brain. The data received may be interesting for the medical anthropology specialists as well as for the neurosurgeons because it may help in determining the stage of the hydrocephalus and in order to objectify the stereotaxic calculations.

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