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Original research article

A STUDY OF MORPHOMETRIC ASSESSMENT OF THE EXTERNAL ANATOMY OF FOURTH VENTRICLE

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Abstract

The diagnosis and classification of hydrocephalus, as well as the assessment and follow-up of ventricular system enlargement during therapy (ventricular shunts), can be aided by morphometric study of the ventricular system. The purpose of this research was to examine the dorsal brainstem and fourth ventricle via the lens of morphometric evaluation.

Keywords: Morphometric, assessment, external anatomy, fourth ventricle

Introduction

Gaining knowledge of the structure of the central nervous system is an essential component of neurosurgery education. The advancement of novel methodologies and the enhancement of current ones heavily rely on the topographic examination of cadaveric specimens [1]. The brain's physical structure and physiological activities are intricate yet vital for maintaining life. The brain directly or indirectly controls several processes such as planning, initiation, voluntary movements, behaviour, memory, sensory and motor functions, hearing, vision, and regulation of visceral functions, starting with the planning and initiation stage [2]. The objective and morphometric investigations of human brain ventricles have gained attention recently due to their association with several illnesses such as schizophrenia, hydrocephalus, tumours, trauma, as well as gender and ageing, which might potentially lead to dementia. Morphometric examination of the ventricular system is useful for diagnosing and categorising hydrocephalus, as well as evaluating and monitoring the expansion of the ventricular system during therapy using ventricular shunts. The objective of this study was to analyse the measurements and proportions of the exterior structure of the fourth ventricle and dorsal brainstem.

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Materials and Methods

The present study was a descriptive study done in the Department of Anatomy. In order to include participants from different parts of South India, we expanded it into a multiple institute study. The study spanned a period of 2 years, from January 2022 to December 2023.

Inclusion criteria

The study examined apparently normal brain specimens obtained from human cadavers with known age and sex.

Exclusion criteria

Brain tissue size may be affected by several disorders, including trauma-related parenchymal injuries, non-traumatic intracranial haemorrhages, ischemic systemic diseases, and intracranial tumours.

We conducted measurements on 60 recently deceased adult bodies. The measurements were performed by two separate investigators, and the average value was calculated. In those situations, two calvarias were opened without histological examination sample, and they were chopped using tentorium scissors. The brainstem was extracted from the foramen magnum.

Subsequently, the entire brain was extracted. The brainstem was dissected and the dimensions of the fourth ventricle and cadaver brainstem were determined using millimetre rulers. The data was gathered and organised using Microsoft Excel, and then analysed using the SPSS 23.0 software. The continuous variables were analysed to determine their frequency, percentage, mean, and standard deviation (SD). The chi-square test or Fisher's exact test was used to assess the difference in proportions between qualitative variables, as appropriate. A P value less than 0.5 was deemed statistically significant.

Results

Table 1: Measurement of fourth Ventricles (in mm)

Parameters	Male (in mm)	Female	P-value
Height of fourth ventricle	26.6	25.8	0.63
Width of fourth ventricle	27.8	27.1	0.75

Various brainstem measurements were comparable among male & females, difference was not significant statistically.

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Table 2: Brain stem Morphometry (in mm)

Morphometric Feature	Male (Mean ± SD)	Female (Mean ± SD)	P value
Length of The Brainstem	57.5	54.16	0.2
Aqueduct Obex (mm)	41.5	40.38	0.8
Lateral Recess Length (mm)	17.39	16.92	0.1
Facial Colliculus-Obex	24.74	22.4	0.8
Aqueduct-Facial Colliculus	23.31	24.1	0.4
Mesencephalon	15.67	16.05	0.5
Pons	31.45	32.83	0.6
Medulla Oblongata	16.51	16.28	0.4
Foramen Luschka (Distance between Right and left)	23.39	24.72	0.7
Distance between Median and Sulcus Limitans	6.57	6.42	0.7
Distance between the 5th cisterns	36.82	37.61	0.4
Distance Between the midlines of Superior and Inferior Colliculus	8.31	7.80	0.5

Discussion

The fourth ventricle, also known as V4, is an enlarged section of the ependymal canal situated between the medulla oblongata and the pons in the front, and the cerebellum in the rear. The rhombencephalic cavity, which consists of the medulla oblongata and pons, is protected by the cerebellum, which originates from the metencephalon. It connects with the midbrain aqueduct above and with other cisterns, including the cerebellar-spinal cistern, below through the telachoroidea of the V4.This anatomical arrangement, which originates from embryology, provides an explanation for the use of the V4 approach through a sub-tonsillar procedure or telovelar approach, while preserving the integrity of the cerebellum. The fourth ventricle can become blocked due to congenital factors such as Dandy Walker malformation, Arnold Chiari malformation Type II with myelomeningocele, and tumours such medulloblastoma, ependymoma, and astrocytoma, resulting in hydrocephalus. The user's text is "[5]". Accurate assessment of ventricular size is essential for diagnosing and monitoring various neurological disorders and abnormalities. Ventricular enlargement is a sign of brain tissue loss [6].

In addition, ventricular size measurements are utilised in research on hydrocephalus, schizophrenia, tumours, trauma, Alzheimer's disease, Parkinson's disease, gender, ageing, and atrophy, which is linked to various neurological conditions such as stroke and dementia, as well as Huntington's disease. These measurements also offer valuable indicators of cerebral asymmetry and atrophy. Tumours and vascular abnormalities situated in the brainstem were deemed inoperable for an extended period due to the substantial likelihood of consequences [9]. Recent advancements in neuroimaging and neurophysiological monitoring, combined with anatomical expertise and the experience of neurosurgeons, have resulted in the improvement of surgical techniques for treating lesions located in or near the brainstem. The given text is "[10, 11]". In a study conducted

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by Shahin *et al*., it was observed that the lateral ventricles exhibit variations in size within specified limits based on factors such as age, sex, and laterality.

Conclusion

The anatomy of the dorsal brainstem plays a crucial role in surgical methods for tumours located in the fourth ventricle. Baseline anatomical baseline data aids in the interpretation of clinical changes, surgical planning, and the assessment of the existence and progression of certain neurological illnesses.

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