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Association of Periventricular Edema Thickness and Optical Perineal Thickness in Hydrocephalus Non Communications by Magnetic Resonance Imaging Examination

Noor Anita Humaira[1], Sri Andreani Utomo[1], Hari Basuki[2]

[1]*Department of Radiology, Faculty of Medicine-Dr.Soetomo General Hospital, Universitas Airlangga, Surabaya, Indonesia,* [2]*Department of Biostatistics and Population, Faculty of Public Health, Universitas Airlangga, Surabaya, Indonesia*

Abstract

Background: Hydrocephalus is a complex neurological disorder that characterized by increased amounts of cerebrospinal fluid and enlargement of the cerebral ventricles also subarachnoid space. Magnetic Resonance Imaging (MRI) is the first choice to diagnose hydrocephalus with better anatomical features. Periventricular interstitial edema is an indication of the presence of hydrocephalus, while Magnification of the diameter in the nerve sheath is an indicator of increased intracranial pressure in humans and apes.

Objectives: To analyze the correlation between the periventricular thickness of edema and optic perineurium thickness in non-communicating hydrocephalus with Magnetic Resonance Imaging (MRI) examination.

Method: The cross-sectional study using secondary data obtained 29 samples that met the criteria from January 2014 to April 2015 which was chosen by consecutive and then analyzed.

Results: Twenty-nine samples consisted of: women 16 (55.2%) and men 13 (44.8%), age <10 months (13.8%), age 10-19 months (34.5%), age 20-29 months (34.5 %), age 30-39 months (6.9%), age ≥39 months (10.3%). The age range of patients between 7 months and 46 months with mean age 21.93 ± 11.35 months. The results of the measurements showed that there was a correlation between the periventricular thickness of edema and the thickness of the optic peri nervus.

Conclusion: There was a correlation between the periventricular thickness of edema and the thickness of the optic peri nervus. The thicker the periventricular edema, the thicker the optic peri nervus.

Keywords : *Periventricular edema, Optic Nerve Opus, Non Hydrocephalus Communicans, Magnetic Resonance Imaging (MRI)*

Introduction

Hydrocephalus is a complex neurological disorder that characterized by increased amounts of cerebrospinal fluid and enlargement of the cerebral ventricles and/or subarachnoid space. Hydrocephalus is remaining an important problem in the world of medicine, especially when correlated with the growth and development of children due to brain growth disorders, so automatic if it was not handled properly and quickly then it will cause disruption in the growth and more severe development, even case and could be fatal.

Statistically found that a good surgical and medical management was only about 40% of hydrocephalus patients have normal intelligence and about 60% have significant intelligence and motor defects. From these statistical data showed that although with neurosurgical treatment and neurosurgical management also good medical management it turns out that about 60% of patients still have a sequel to meaningful disorders.

Although many are found in infants and children, hydrocephalus actually possible occurs in adults. In infants the clinical symptoms appear more clearly,

Correspondence Author
Sri Andreani Utomo
Email : sriandreaniutomo48@yahoo.com

making it easier to diagnose. This is because the baby's head is still open so that the accumulation of brain fluid could be compensated by the widening of the skull bones. Infants with moderate and severe hydrocephalus require VP shunt and growth is favorable in 87% of cases [1] . Seen by the enlarged diameter of the head of the increasingly larger due to the increase of the pile of cerebrospinal fluid. While in adults, skull bones are no longer able to widen. As a result, no matter how much cerebrospinal fluid is accumulated, it will not be able to increase the diameter of the head.

Prevalence of hydrocephalus 4.65 every 10,000 births. The incidence rate in the world is uncertain. The incidence of infantile hydrocephalus is estimated to be 0.6 every 1,000 births, possibly occur at any age, fetus, perinatal and neonatal. From 2010 data, hydrocephalus tops the Neuropediatric Surgery Division of Dr, Soetomo General Hospital and is in the 7th position of all neurosurgery cases (outpatient and inpatient) [2].

The characteristic of acute hydrocephalus is the presence of low-density periventricular bands on CT, low on T1, and high on T2 / FLAIR in MRI that reflecting what is described as periventricular interstitial edema [3]. Shofty et al's 2012 study stated a significant correlation between widening of optic nerve diameter and its envelope with increased ICT in patients with Idiopathic Intracranial Hypertension (IIH) patients compared to healthy patients. Measurements of optic nerve diameter and sheath were performed with MRI 1.5 T axial pieces with T2 sequences at the anterior 10 mm point of the optic foramen [4] .

Neuroimaging is important for the diagnosis and management of hydrocephalus. MRI is the first option for examination to get better anatomic details in diagnosing the cause of hydrocephalus, that allows for the better morphological definition of various central nervous system structures, cerebrospinal fluid space, periventricular edema, and lesions. Various pieces of images could be obtained (axial, sagittal, and coronal); bone structure usually does not interfere with the identification of intrathecal structures, and, like ultrasound, MRI is not the source of ionizing radiation. MRI is also useful for evaluating cerebrospinal fluid flow (CSF) and localization of obstruction in the case of hydrocephalus.

Method

Consecutive sampling was used with the criteria of patients aged 0-3 years hydrocephalus noncommunicans that diagnosed with MRI examination from January 2014 to April 2015 at the Radiodiagnostic Installation of Dr. Soetomo General Hospital Surabaya. Methods were a measurement of the periventricular thickness of edema and thickness of neural nerve of the optic nerve at sequence T2 or FLAIR, conducted by a researcher under supervision from the supervisor as a consultant of neuroradiology.

Hydrocephalus is a pathological condition due to an imbalance between production and cerebrospinal fluid absorption resulting in ventricular dilatation and increased intracranial pressure [5,6] .While Hydrocephalus noncommunicans is a circulation of cerebrospinal fluid circulation in the ventricular system itself. Periventricular edema is a low-density periventricular band of T1 in MRI, and high in T2 / FLAIR in MRI, reflecting what is described as periventricular interstitial edema, in this study periventricular edema was measured in the lateral posterior ventricle. The optic nerve diameter is a measure of the diameter of the optic nerve sheath as measured by the head MRI with T2 sequence, measured at 10 mm anteriorly from the optic foramen. The value of the optic nerve sheath diameter is expressed by millimeters (mm). MRI used is MRI 1.5 Tesla with brand Optima MR360w 1.5T.

Furthermore, the results of MRI examinations that have been collected were measured and then arranged in tabular form, and then performed with a correlation test by Spearman. **Results**

This research was conducted to find out the correlation between the periventricular thickness of edema and optic peri nervus thickness in patients with non-communicative hydrocephalus. The total sample was 29 patients in 15 months from January 2014 to April 2015. The research data was obtained in the form of measurement of the periventricular thickness of edema with the thickness of the optic peri nervus in non-communicative hydrocephalus patients.

Distribution of Patients by age group

The mean age of patients was 21.93 ± 11.35 months. The youngest was 7 months old and the oldest was 46. Distribution of patient age is shown in table 1.

Table 1. Distribution of patients by age group

Age category	Frequency	Percentase
<10 Months	4	13.8
10 – 19 Months	10	34.5
20 – 29 Months	10	34.5
30 – 39 Months	2	6.9
≥39 Months	3	10.3
Total	29	100.0

Distribution of Patients by Sex

Based on sex, 16 males and females were 13 patients. In table 2 is shown the results of the distribution of patients by sex.

Table 2 Distribution of patients by sex

Sex	Frequency	Percentase
Male	16	55.2
Female	13	44.8
Total	29	100.0

Periventricular thickness of Edema and Perinervus Optical Thickness

Based on table 3 it was explained that the result of analysis with Spearman correlation shows rs = 0.458 and p = 0.012 ($p < 0.05$) which means there was a correlation between the periventricular thickness of edema and optical peri nervus thickness. The thicker the periventricular edema, the thicker the optic peri nervus.

Table 3. Measurement results of Periventricular Thickness of Edema and Perinervus Optical Thickness

Thickness	N	Median	Minimum	Maximum	Correlation
Periventricular Edema	29	1.04	0.74	Difficult to evaluate (severe HC)	rs=0.458 p=0.012
Perinervus Optical	29	1.01	0.75	1.43	

Discussion

This research was conducted for 15 months and obtained 29 patients as samples who meet the criteria of the study sample. Based on that number, the youngest patient aged was 7 months and the oldest was 46 months. Hydrocephalus could occur at any age, fetus, perinatal and neonatal with an incident reported 0.48-0.81 every 1,000 live births [7].

Based on sex, 29 patients consisted of 16 men (55.2%) and 13 women (44.8%). There was no significant difference in incidence for both sexes [8]. Ioncidence in male and female sex was the same, except in Bickers-Adam syndrome, X-linked hydrocephalus was transmitted by women and manifested in men[9].

Hydrocephalus was characterized by cerebrospinal fluid imbalance (CSF) in its formation and absorption, this was manifested by dilatation of the ventricular system. Approximately 55% of all cases of hydrocephalus were congenital. There were two types of hydrocephalus: communicant and non-communicating with subarachnoid space and the diagnosis could be established by examination of Computed Tomography (CT) and Magnetic Resonance (MR).

Hydrocephalus was not a disease, but a dynamic process that takes place in the size of the ventricular system change[10]. Increased water in the brain parenchyma could be detected by both CT and MRI. The CT appears as hypodensity in the periventricular and the ventricular layer becomes unclear. MRI appears to be the hyperintense rim around the lateral ventricle in Fluid Attenuated Inversion Recovery (FLAIR) or proton imaging density [11].

Previous research has shown that ultrasonography and MRI could be used to measure the diameter of the optic nerve sheath in normal dogs. Magnification of the diameter of the nerve sheath was an indicator of increased intracranial pressure in dogs. Research on humans and monkeys shows that increased intracranial pressure that measured by increasing in diameter on the optic nerve sheath. Furthermore, measurements of optic nerve sheath diameters in humans by using Magnetic Resonance Imaging (MRI) [12]. MRI could help to identify ventricular enlargement due to hydrocephalus by the presence of high-signal halo periventricular on T2-weighted imaging. But there was a high periventricular T2 signal change as a result of the microvascular disease also could be seen [13].

The diameter of the optic nerve sheath has been found to be a strong predictor of increased intracranial pressure, with high sensitivity and specificity in some studies also in systematic reviews. The increased intracranial pressure was a rapid emergency which has a significant impact on morbidity and mortality [14]. Optical nerves and surrounding envelopes could be image and measured on MRI using fat-suppressed T2-weighted sequences [15]. From the results, there was a correlation between the periventricular thickness of edema and optical peri nervus thickness. The thicker the periventricular edema, the thicker the optic peri nervus.

Conclusion

There was a correlation between the periventricular thickness of edema and the thickness of optic peri nervus in non-communicative hydrocephalus patients with MRI examination in Dr. Soetomo General Hospital Surabaya. The result was; there was a correlation (rs = 0.458) between the periventricular thickness of edema and optic peri nervus thickness. The thicker the periventricular edema, the thicker the optic peri nervus.

Ethical Clearance: This study protocol was approved by ethical clearance Dr.soetomo Surabaya, Indonesia teaching hospital research.

Conflict of Interest: The author reports no conflict of interest of this work.

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