



Original article

Evaluation index for asymmetric ventricular size on brain magnetic resonance images in very low birth weight infants

Toshihiko Ikuta^{a,b}, Masami Mizobuchi^{b,1}, Yoshinori Katayama^c, Seiji Yoshimoto^b,
 Tomoaki Irooi^d, Masayuki Yamane^e, Takeshi Morisawa^f, Akihiro Takatera^g,
 Masaaki Ueda^h, Akio Shibataⁱ, Kaori Maeyama^a, Tsurue Mandai^a,
 Kazumichi Fujioka^a, Noriyuki Nishimura^a, Kazumoto Iijima^a, Ichiro Morioka^{a,*,2}

^a Department of Pediatrics, Kobe University Graduate School of Medicine, Kobe, Japan

^b Department of Neonatology, Hyogo Prefectural Kobe Children's Hospital, Kobe, Japan

^c Department of Pediatrics, Takatsuki General Hospital, Takatsuki, Japan

^d Department of Pediatrics, Japanese Red Cross Society Himeji Hospital, Himeji, Japan

^e Department of Pediatrics, Saiseikai Hyogo General Hospital, Kobe, Japan

^f Department of Pediatrics, Kakogawa Central City Hospital, Kakogawa, Japan

^g Department of Pediatrics, Chibune General Hospital, Osaka, Japan

^h Department of Pediatrics, Toyooka Hospital, Toyooka, Japan

ⁱ Department of Pediatrics, Hyogo College of Medicine, Nishinomiya, Japan

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Abstract

Objective: Asymmetric ventriculomegaly is often evident on brain magnetic resonance imaging (MRI) in very low birth weight infants (VLBWI) and is interpreted as white matter injury. However, no evaluation index for asymmetric left-right and anterior-posterior ventricular sizes has been established.

Methods: In this retrospective multicenter cohort study, brain T2-weighted MRI was performed at term-equivalent ages in 294 VLBWI born between 2009 and 2011. The value of a lateral ventricular index (LVI) to evaluate asymmetric ventricular size, as well as the relationship between the LVI value and walking at a corrected age of 18 months was investigated. At the level of the foramen of Monro in a horizontal slice, asymmetry between the left and right sides and between the anterior and posterior horns was identified by the corrected width and was detected by a low concordance rate and κ statistic value. An LVI representing the sum of the widths of the four horns of the lateral ventricle corrected for cerebral diameter was devised.

Results: Asymmetric left-right and anterior-posterior ventricular sizes were confirmed. The LVI value was significantly higher in the non-walking VLBWI group ($n = 39$) than in the walking VLBWI group ($n = 255$; 18.2 vs. 15.8, $p = 0.02$). An LVI cut-off value of 21.5 was associated with non-walking. Multivariate analysis revealed that an LVI value >21.5 was an independent predictor of walking disability at the corrected age of 18 months (odds ratio 2.56, $p = 0.008$).

* Corresponding author at: Department of Pediatrics, Kobe University Graduate School of Medicine, 7-5-1, Kusunoki-cho, Chuo-ku, Kobe 6500017, Japan.

E-mail address: ichim@med.kobe-u.ac.jp (I. Morioka).

¹ Present address: Department of Developmental Pediatrics, Shizuoka Prefectural Shizuoka Children's Hospital, Shizuoka, Japan.

² Present address: Department of Pediatrics, Nihon University School of Medicine, Tokyo, Japan.

Conclusions: The LVI value calculated via MRI may predict walking disability at a corrected age of 18 months in VLBWI.
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Keywords: Lateral ventricle; Magnetic resonance imaging; Motor development; Very low birth weight infants; Walking

1. Introduction

In Japan, the survival rate of very low birth weight infants (VLBWI; birth weight <1500 g) has improved since 2000 [1], such that the mortality rate of infants born at a gestational age of 24–31 weeks was only 5% in 2007 to 2010 [2]. However, cerebral palsy is identified in approximately 10% of surviving VLBWI [3].

The immature blood vessels and glia in the brains of VLBWI are susceptible to ischemia and inflammation [4], rendering these infants prone to diffuse white matter injury. Especially, periventricular leukomalacia (PVL) and intraventricular hemorrhage (IVH) cause decreases in white matter volume, resulting in enlargement of the lateral ventricles in VLBWI [5,6].

Neuroimaging at term-equivalent ages has been studied in VLBWI to predict the neurodevelopmental outcome [7]. Ment et al. reported that ventricular size at term-equivalent age was an independent predictor of adverse cognitive and motor development at a corrected age of 4 years [8]. However, other studies have shown that ventricular size has a limited ability to predict the neurodevelopmental outcome in the absence of other pathologic lesions [9–11]. No conclusion has been reached regarding the association between ventricular

size and neurodevelopmental outcome, possibly on account of the lack of a definitive method for evaluation of ventricular size in VLBWI; the lack of both symmetry and uniform enlargement of the ventricles in VLBWI may explain the absence [12,13].

The aims of the present study were to devise an index for the evaluation of asymmetric left-right and anterior-posterior ventricular size in VLBWI using brain magnetic resonance imaging (MRI) at term-equivalent ages, as well as to study the relationship between this index and unaided walking at 18 months of corrected age.

2. Materials and methods

2.1. Study design and subjects

Of the VLBWI born in 2009–2011 and treated in the neonatal intensive care unit at Kobe Children's Hospital, Kobe University Hospital, Takatsuki General Hospital, Japanese Red Cross Society Himeji Hospital, Saiseikai Hyogo General Hospital, or Toyooka Hospital, 346 were enrolled in this retrospective multicenter cohort study. The study protocol was approved by the ethics committees at Kobe University Graduate School

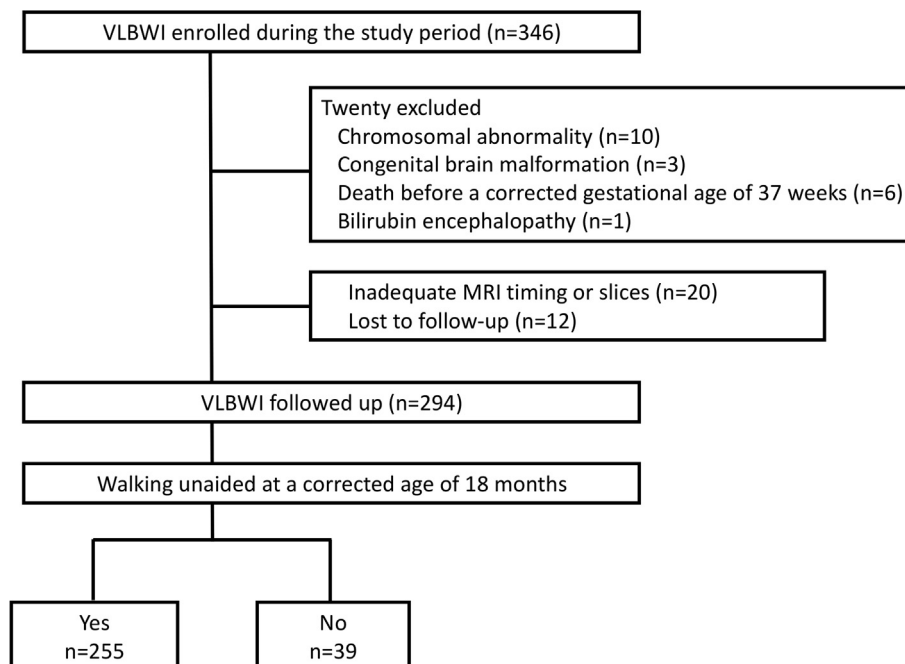


Fig. 1. Flow of subjects through the study. MRI, magnetic resonance imaging; VLBWI, very low birth weight infants.

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