

REGULAR ARTICLE

Ultrasound lineal measurements predict ventricular volume in posthaemorrhagic ventricular dilatation in preterm infants

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ABSTRACT

Aim: Posthaemorrhagic ventricular dilatation (PHVD) is monitored by conventional two-dimensional ultrasound (2DUS). The aims of this study were to determine the volume of the lateral ventricles using three-dimensional ultrasound (3DUS) in preterm infants with PHVD and to evaluate the relationship between volume and linear measurements.

Methods: Serial 2DUSs and 3DUSs were performed on preterm infants with PHVD admitted to the neonatal intensive care unit at Puerta del Mar Hospital, Cádiz, Spain, from January 2013 to December 2014. The ventricular index, anterior horn width and thalamo-occipital distance were used as ventricular lineal measurements. Ventricular volume was calculated offline.

Results: Serial ultrasounds from seven preterm infants were measured. Each linear measurement was significantly associated with volume, and an equation was obtained through a significant multilevel mixed-effects lineal regression model: ventricular volume (cm^3) = $-11.02 + 0.668 \cdot \text{VI} + 0.817 \cdot \text{AHW} + 0.256 \cdot \text{TOD}$. Intra-observer and interobserver agreement was excellent with an intraclass correlation coefficient of 0.99.

Conclusion: Lateral ventricular volumes of preterm infants with PHVD could be reliably determined using 3DUS. Ventricular volume could be accurately estimated using three lineal measurements. More studies are needed to address the importance of volume determination in PHVD.

INTRODUCTION

Despite advances in neonatal care, germinal matrix intra-ventricular haemorrhage (GM-IVH) is a complication that occurs frequently in preterm neonates (1). The incidence of this entity ranges from 18% to 38% and is inversely related to gestational age (2). Posthaemorrhagic ventricular dilatation (PHVD) occurs in approximately one-third of preterm neonates with severe GM-IVH (1). It is most commonly defined as a ventricular enlargement, with a ventricular index (VI) according to Levene, that exceeds the 97th percentile for gestational age (3,4). PHVD secondary to GM-IVH that requires a shunt has shown to be a marker of poor neurodevelopmental outcome (3). Serial two-

dimensional ultrasound (2DUS) measurements allow the diagnosis and follow-up of PHVD. Several lineal measurements have been described by different research groups (4–7), but the ones that are most widely used in routine practice are VI, anterior horn width (AHW) and thalamo-occipital distance (TOD).

Ventricular volume through three-dimensional ultrasound (3DUS) appears to be an accurate technique that

Abbreviations

2DUS, Two-dimensional ultrasound; 3DUS, Three-dimensional ultrasound; AHW, Anterior horn width; GM-IVH, Germinal matrix intraventricular haemorrhage; ICC, Intraclass correlation coefficient; NICU, Neonatal intensive care unit; PHVD, Posthaemorrhagic ventricular dilatation; r, Pearson's correlation coefficient; TOD, Thalamo-occipital distance; VI, Ventricular index; VOCAL, Virtual organ computer-aided analysis.

Key notes

- Posthaemorrhagic ventricular dilatation (PHVD) in preterm infants is usually monitored by two-dimensional ultrasound using lineal measurements, but little is known about how they reflect ventricular volume.
- This study showed how three-dimensional ultrasound (3DUS) produce highly accurate serial volume measurements of lateral ventricles and how lineal measurements were related to volume.
- Further research is needed to address the role of 3DUS in PHVD in preterm infants.