Effect of Grade I and II Intraventricular Hemorrhage on Visuocortical Function in Very Low Birth Weight Infants

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Abstract
The neurological outcome for infants with Grade I/II intraventricular hemorrhage (IVH) is debated. The aim of this study was to determine whether very low birth weight infants (VLBW, <1500 g) with Grade I/II (IVH) have altered visuocortical activity compared with infants with no IVH. We assessed the quantitative swept parameter visual evoked potential (sVEP) responses evoked by three different visual stimuli. Data from 52 VLBW infants were compared with data from 13 infants with Grade I or II IVH, enrolled at 5–7 months corrected age. Acuity thresholds and suprathreshold response amplitudes were compared. Grating acuity (GA), contrast sensitivity (CS) and vernier acuity (VA) were each worse in the Grade I/II IVH compared with the no IVH groups (8.24 cpd in IVH group vs. 13.07 cpd in no IVH group for GA; 1.44% vs. 1.18% for CS and 1.55 arcmin vs. 0.58 arcmin for VA). The slopes of the response amplitude for CS and VA were significantly lower in IVH infants. The spatial frequency tuning function was shifted downward on the spatial frequency axis, without a change in slope. These results indicate that Grade I/II IVH are associated with deleterious effects on cortical vision development and function.

Keywords
Prematurity, intraventricular hemorrhage, swept parameter visual evoked potentials, contrast sensitivity, spatial frequency, vernier acuity

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List of Abbreviations

VLBW very low birth weight  
sVEP swept parameter visual evoked potentials  
ROP retinopathy of prematurity  
IVH intraventricular hemorrhage  
PVL periventricular leukomalacia  
CS contrast sensitivity  
GA grating acuity  
VA vernier acuity

1. Introduction

Advances in neonatal and perinatal medicine have resulted in improved survival of very low birthweight (VLBW) infants (Stevenson et al., 1998). However, these infants remain at high risk for neurodevelopmental handicap in the long term (Hack et al., 1995; McCormick et al., 1992). Cognitive impairments in these children can range from severe mental retardation to subtle neurological dysfunction such as attention deficits, behavior problems, visuo-motor, visuo-spatial, and fine and gross motor dysfunction (Hack and Taylor, 2000; Woodward et al., 2005). Several of the more subtle problems are not detectable until school age, and school performance is compromised in a large percentage of VLBW infants (Hille et al., 1994; Hunt et al., 1988).

Several studies have shown that intraventricular hemorrhage (IVH), particularly Grade III/IV IVH is one of the major causes of adverse neurological outcome (Vohr et al., 2003). Each of these studies has utilized cranial ultrasound to diagnose IVH. An IVH occurs when blood vessels near the lateral ventricles of the brain bleed. Grade I is blood in the periventricular germinal matrix; Grade II, blood within the lateral ventricles without ventricular dilatation; Grade III, blood within and distending the lateral ventricles; and Grade IV, blood within the ventricular system and parenchymal (i.e., direct brain) involvement. Hack et al. reported the following incidence of IVH in a cohort of VLBW infants; Grade I — 17%, Grade II — 10%, Grade III — 11% and Grade IV — 7% (Hack et al., 1991). Although Grade I and II hemorrhage is the most common cranial ultrasound abnormality in preterm infants, the effect of these milder hemorrhages on neurological outcome is less apparent. Some studies have shown milder IVH to have no effect on measures of cognitive outcome when compared to infants with normal ultrasounds (Whitaker et al., 1990, 1996). In contrast other studies, including the most recent by Patra et al. (2006), have shown a subtle downward (worse) trend in the scores on the Bayley Scales of