ORIGINAL ARTICLE

A report on early neurodevelopmental outcomes in extremely low birth weight infants managed on early nasal continuous positive airway pressure

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Abstract

At our institution a policy of early nasal continuous positive airway pressure (ENCPAP) in extremely low birth weight (ELBW) infants has been followed during the past 5 years. Routine intubation and surfactant administration is no longer our practice. The impact of this policy on infant outcomes is under investigation. This is a retrospective review of ELBW infants (<1000 g) born at our institution between January 1998 and July 2002. Data on hearing deficits, visual impairment and Bayley scores at 3-6 months of corrected age were analyzed. Ninety-two ELBW infants were identified. Sixteen (17.4%) infants died and 14 (15.2%) ELBW were transferred to another institution. For the 62 survivors discharged home, mean gestational age was 26.4±1.6 wks and birth weight was 797±129 g. The majority (67%) of these ELBW infants were managed with ENCPAP. Three (10.3%) infants had abnormalities on hearing evaluation. Three (4.8%) infants had retinopathy of prematurity requiring laser. Thirty infants were followed developmentally. Four of these infants had normal neurodevelopmental evaluation at 6-8 weeks corrected age, and did not return for further follow-up. Twenty-six infants were followed at least through the three to six month visit. Six (23%) remained on high calorie formula with four (14%) infants requiring nasogastric tube feeding. Seven (25%) infants had Bayley mental developmental index <70 (<2 SD) and seven (25%) infants had Psychomotor Developmental Index <70. Neurodevelopmental morbidity remains a concern for ELBW infants managed with ENCPAP. Although these results are subject to selection bias, the rates of neurodevelopmental morbidity are similar to those reported in the recent literature. (J Pediatr Neurol 2004; 2(3): 147-150).

Key words: extremely low birth weight infants, neurodevelopmental outcome, continuous positive airway pressure.

Introduction

A recent report from the National Institute of Child Health and Human Development (NICHD) Neonatal Research Network showed significant neurodevelopmental morbidity for extremely low birth weight (ELBW) infants, demonstrating Bayley developmental indices greater than two standard deviations below the mean in approximately one-third of patients (1). Recently, several reports on the use of early nasal continuous positive airway pressure (ENCPAP) have demonstrated favorable neonatal intensive care unite (NICU) outcomes such as decreased rates of chronic lung disease (2-4), retinopathy of prematurity (ROP) (4) and intraventricular hemorrhage (IVH) (3). None of these reports included neurodevelopmental outcome data. One would expect a concurrent improvement in neurodevelopmental outcomes. However, some may argue that these infants managed with ENCPAP may be exposed to hypoventilation, acidosis and/or hypercapnia that can adversely affect neurodevelopmental outcome. Therefore, we
decided to explore possible benefits or disadvantages in neurodevelopmental outcome for ELBW infants managed with ENCPAP in our NICU.

**Materials and Methods**

Infants born less than 1000 grams at our institution between January 1998 and July 2002 were identified retrospectively. During this time period, a policy towards ENCPAP was instituted. Routine intubation, surfactant administration and mechanical ventilation have been replaced by an individualized respiratory management strategy that allows for immediate ENCPAP use for infants with spontaneous respiratory efforts. Information regarding the infants’ NICU course, including demographic and respiratory data, were compiled from the medical records. Additionally charts were reviewed at the infant development clinic, to where all graduates from our NICU were referred. Internal review board approved this study. Bayley Scales of Infant Development II scores at the 3 to 6 month corrected age visit were collected and used as markers of early neurodevelopmental status (5). In addition, information regarding hearing deficits, visual impairment and required feeding interventions were also noted. Hearing deficits were defined as abnormalities on an otoacoustic emissions screen (OAE) prior to discharge from the NICU or brainstem auditory evoked response (BAER) done in the NICU or after discharge. Visual morbidity was indicated by incidence of threshold ROP requiring laser surgery.

**Results**

An overall 92 ELBW infants were born at our institution during the study period. Sixteen infants (17.4%) died and 14 infants (15.2%) were transferred to Children’s National Medical Center for surgical interventions (due to necrotizing enterocolitis or patent ductus arteriosus). Four of the 16 deaths (25%) were originally managed with ENCPAP. This report describes neurodevelopmental outcomes of the 62 surviving infants who were discharged to home from our institution. The mean gestational age of these 62 ELBW infants was 26.4±1.6 weeks and birth weight was 797±129 g (range 513-965 g). The majority of these infants (n=41, 67%) were managed with ENCPAP. Infant development clinic follow-up records were available for 30 infants; 23 (77%) infants managed with ENCPAP, and seven (23%) infants were mechanically ventilated. Four of these infants had normal neurodevelopmental evaluation at 6 to 8 weeks corrected age and did not return for further follow-up. Twenty- six infants were followed at least through the three to six month corrected age visit. Demographic information, respiratory data, and incidence of IVH were similar to the population that was lost to follow-up and are presented in Table 1. Average maternal age for the follow-up population was 30.5±5.8 years and mean maternal parity was 2.1±1.1.

**Hearing deficits**

Twenty-nine (90.6%) of the infants that followed up at the development clinic had results of hearing evaluations noted in the medical records. The majority (65.5%) of these evaluations were done by the OAE screening test performed prior to discharge from the NICU. The remainders were evaluated with a BAER test. Three (10.3%) infants had abnormal hearing evaluations. Two infants had abnormal OAE hearing screens prior to discharge from the NICU had no confirmatory hearing evaluation yet noted in the medical record. One additional infant had an abnormal BAER at follow-up.

**Retinopathy of prematurity**

Three (4.8%) of the survivors discharged from the NICU had ROP requiring laser surgery. Another 14 infants had less severe disease (ROP stage I or II).

**Required feeding interventions**

No infants were noted to require adapted nipples to feed, however four infants had been discharged home on nasogastric tube feedings with three (10.7%) of them still requiring them at follow-up. Six (23 %) infants were on high calorie formulas (24 cal/30 ml) at the 3 to 6 month follow-up visit.

**Bayley scores of infant development**

Six infants had both Bayley Mental Developmental Index (MDI) and Psychomotor Developmental Index (PDI) less than 70 (greater
than 2 standard deviations below the mean). Two additional infants had this level of delay on only one index (i.e. one infant had MDI <70 and another had PDI <70). Thus, the incidence of significant delay in either index was 25%. Ten (35.7%) infants were noted to be receiving physical and/or occupational therapy services.

Discussion

Neurodevelopmental outcome of our population is comparable to those of the NICHD Neonatal Research Network which reported that 37% of ELBW infants had Bayley MDI <70, 29% had PDI <70, 9% had visual impairment and 11% had hearing deficits at 18 months corrected age (1). This report does not help in proving any advantageous affect on neurodevelopmental outcome with ENCPAP use. However, it shows that ELBW infants managed with ENCPAP did not appear to have increased risk for hearing/visual impairment or higher incidence of severe delays on Bayley Scales of Infant Development. In addition, our recent report showing that ELBW infants managed with NCPAP in the first week of life are able to maintain their partial pressure of carbon dioxide in the normal range alleviates concerns about the theoretical hypoventilation, acidosis and/or hypercapnia and any resulting adverse affects on neurodevelopmental outcome (6). These reports may be encouraging and should help physicians to recognize that these ELBW infants are not disadvantaged when managed on ENCPAP.

In our NICU, we have noted an increase in overall survival since the institution of the ENCPAP policy (73.3% in the preceding two years versus 82.4% during the study period). We recognize that ENCPAP may not be appropriate for critically ill ELBW infants. Of note, only four of the 16 mortalities were on ENCPAP. This preliminary data. A prospective study which would ensure higher rates of follow-up and less selection bias is being planned.

ELBW infants managed with ENCPAP have early neurodevelopmental morbidity comparable to nationally recognized figures. There does not appear to be any benefit nor disadvantageous affect on neurodevelopmental outcome associated with ENCPAP use in this population. It is important that neurodevelopmental outcome be a primary outcome measure in any upcoming clinical trial on ENCPAP in ELBW infants.

References

in extremely low birth weight infants supported by nasal prongs continuous positive airway pressure. Pediatrics 2003; 112: 208-211.


