An occurrence of apnea, bradycardia, and desaturation events resulting in a delay of discharge in late preterm and full term infants

ARTICLE IN PRESS
+ MODEL
Pediatrics and Neonatology (2018) xx, 1—2

Available online at www.sciencedirect.com
ScienceDirect
journal homepage: http://www.pediatr-neonatol.com

Short Communication

An occurrence of apnea, bradycardia, and desaturation events resulting in a delay of discharge in late preterm and full term infants

Brian Montenegro [a], Christina Freiberger [b], Lauren Veit [c], Michael Amberson [d], Sagori Mukhopadhyay [e], Lawrence Rhein [f,*]

[a] Division of Newborn Medicine, Boston Children's Hospital, USA
[b] Boston College, USA
[c] Division of Medicine, Boston Children's Hospital, USA
[d] Boston University School of Medicine, USA
[e] Division of Neonatology, Children's Hospital of Philadelphia, USA
[f] Division of Newborn Medicine, University of Massachusetts Medical School, USA

Received May 20, 2016; received in revised form Oct 16, 2016; accepted Nov 14, 2016
Available online ■ ■ ■

Apnea, bradycardia, and oxygen desaturation (ABD) events together encompass one of the most ubiquitous problems encountered in the neonatal intensive care unit (NICU), with persistent events often resulting in variable lengths of stay.[1] ABD events have been well studied in infants born prior to 34-weeks gestational age (GA), although they also affect 4%–12% of late preterm infants born at >34 0/7 to 36 6/7 weeks GA.[2,3] The clinical significance of immaturity-related ABD events in the late preterm and full term population is unclear. Intermittent hypoxia has been associated with poor neurodevelopmental outcomes and retinopathy of prematurity in extremely preterm infants.[4] Available data pertaining to late preterm infants is remarkable for a trend toward impaired neurodevelopment, although a relationship to ABD events is not yet been studied.[5] The persistence of ABD events beyond the achievement of other discharge-delaying milestones, especially in a population of near term infants, presents a clinical conundrum for the caregiver team. Moreover, the proportion of late preterm and full term infants, specifically affected by discharge-delaying ABD events, remains unknown.

In a 5-year retrospective study, we identified a population of late preterm and full term infants with ABD events as the last discharge-delaying diagnosis. The inclusion criteria included birth at ≥34 0/7 weeks GA and a documented ABD event within 10 days before the NICU discharge at Beth Israel Deaconess Medical Center (BIDMC) and Brigham and Women's Hospital (BWH) between January 1, 2009 and December 31, 2013. Monitor alarm settings at both institutions were for apnea ≥20 s, bradycardia ≤80 beats per minute, and oxygen saturation <90 percent. Infants were excluded if any other diagnosis, such as temperature

* Corresponding author. Division of Newborn Medicine, University of Massachusetts Medical School, Worcester, MA, USA.
E-mail address: Lawrence.Rhein@umassmemorial.org (L. Rhein).

https://doi.org/10.1016/j.pedneo.2016.11.007

instability or feeding maturity, was the primary morbidity responsible for the discharge delay. In addition, we sought to include only infants with immaturity-related ABD events. Therefore, infants were additionally excluded if any alternative cause of ABD events, such as chromosomal abnormalities, anatomic abnormalities of the face or airway, sepsis, necrotizing enterocolitis, intraventricular hemorrhage, a seizure, or cyanotic congenital heart disease, was identified. The study was reviewed and approved with a waiver of consent by the Institutional Review Boards of Boston Children's Hospital, BIDMC, and BWH.

Over the 5-year study period, 59,968 infants were inborn at GA $\geq$ 34 0/7 weeks. The incidence of an ABD event for the entire population was 1.8% (N = 1077). After the application of pertinent exclusion criteria, 1.2% (N = 741) experienced an ABD event as the final discharge-delaying diagnosis [Supplementary Fig. 1]. The late preterm infants accounted for 75% of our final study cohort with most identified with ABD events via car seat testing prior to discharge. According to the US National Census Bureau, in the years included in our study (2009–2013), there were almost 20 million live births in the United States.[6] Extrapolating our study data, approximately 238,000 late preterm and full term infants in the United States would have had a prolonged length of stay owing to an ABD event during our study period presenting an opportunity for quality improvement via a standardized management approach. Interestingly, a prolonged stay from the date that an ABD event became the final discharge-delaying was not significantly associated with a history of surfactant administration, mechanical ventilation, or CPAP, suggesting that prior respiratory support was not predictive of a prolonged stay secondary to ABD events (Supplementary Table 1).

Two key aspects of our study require further consideration. First, our study population was limited to two large academic tertiary-care institutions in Boston with 50% of the infants identified as white, followed second by 11% identified as Asian (Supplementary Table 2). Therefore, caution should be taken in generalizing our data. Second, our study likely underestimates the true incidence of ABD events among late preterm and full term infants admitted to a well nursery in the absence of continuous cardiorespiratory monitoring. Universal monitoring of a well cohort of level 1 nursery infants would almost certainly identify a subset of infants with previously unidentified ABD events. Such was the case in the Collaborative Home Infant Monitoring Evaluation (CHIME) study, whereby 2.3% of seemingly healthy full term infants were noted to have significant apneic events on home monitoring.[7]

In summary, our study focused on a population of late preterm and full term infants that experienced discharge-delaying ABD events, highlighting the burden of disease in this vulnerable population of infants. ABD events in the late preterm and full term population have significant implications on the length of stay, cost, and quality of life. Ideally, future research will help to establish optimal management protocols for late preterm and full term infants.

Conflict of Interest

The authors have no conflicts of interest to report.

Acknowledgments

No external funding was secured for this study. The authors have no financial relationships relevant to this article to disclose.

References

1. Eichenwald EC, Zupancic JA, Mao WY, Richardson DK, McCormick MC, Escobar GJ. Variation in diagnosis of apnea in moderately preterm infants predicts length of stay. *Pediatrics* 2011;**127**:e53–8.
2. Barrington K, Finer N. The natural history of the appearance of apnea of prematurity. *Pediatr Res* 1991;**29**:372–5.
3. Engle WA, Tomashek KM, Wallman C, Committee on Fetus and Newborn, American Academy of Pediatrics. "Late-preterm" infants: a population at risk. *Pediatrics* 2007;**120**:1390–401.
4. Poets CF, Roberts RS, Schmidt B, Whyte RK, Asztalos EV, Bader D, et al. Association between intermittent hypoxemia or bradycardia and late death or disability in extremely preterm infants. *JAMA* 2015;**314**:595–603.
5. Woythaler MA, McCormick MC, Mao WY, Smith VC. Late preterm infants and neurodevelopmental outcomes at kindergarten. *Pediatrics* 2015;**136**:424–31.
6. Martin JA, Hamilton BE, Osterman MJ, Curtin SC, Matthews TJ. Births: final data for 2013. *Natl Vital Stat Rep* 2015;**64**:1–65.
7. Ramanathan R, Corwin MJ, Hunt CE, Lister G, Tinsley LR, Baird T, et al. Cardiorespiratory events recorded on home monitors: comparison of healthy infants with those at increased risk for SIDS. *JAMA* 2001;**285**:2199–207.

Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.pedneo.2016.11.007.