Sensory Stimuli: How They Impact Premature Infants

By Jane Scott, MD

In today’s neonatal intensive care units (NICUs), staff members have become adept at keeping even the most fragile preterm infants alive until they have developed to a level of medical stability to thrive outside of a hospital setting. Often this requires interventions such as continuous supplemental heat, intravenous fluids, medications, invasive and noninvasive respiratory support, and many other life-saving modalities.

However, research has shown that these interventions can potentially have negative consequences for these children – medically, psychologically, and behaviorally – throughout their lives. Babies who spent time in the NICU are at an increased risk for attention deficit disorder, behavior problems, and learning difficulties.

The NICU’s characteristic noise, cool and dry air, lighting, and life-saving equipment differ strongly from the natural in-utero environment where the fetus is supported by warm amniotic fluid and protected by stable uterine walls.

Negative consequences also appear to be closely associated with the day-to-day stresses on preterm babies in the NICU, including excessive noise, bright lights, cold and heat, and frequent manipulation and procedures. To ensure better long-term outcomes, there must be an increased focus on providing more humanized care that places priority on the infant’s current and future health and includes their family.

**Noise**

Sound is one of the most pervasive stimuli in the NICU and is perceived differently through the tissues of the womb. For the preterm infant, this is a time when auditory development is taking place and sleep can be affected by constant startles. Noise may also cause physiological stress, which can impact cognitive development and increase length of stay.

Several studies performed in NICUs, both in the United States and overseas, have consistently noted that the recommended noise levels have been violated with hourly levels ranging from 53.9 dB to 60 dB, day and night. While nurses report that they believe that the dayshift noise level is louder due to the increased activities and staff present, studies have not substantiated these beliefs, nor their belief that the NICU is quiet. Nurses often attribute increased sound to monitors, procedures, presence of family, doctor-nurse reports or even phones. However, certain types of beds and respiratory support systems are among the largest contributors of noise pollution in the NICU.¹ We are also now learning that much of the noise in the NICU comes from the building itself, which can be greater than 40dB.

So what can be done to keep noise levels down? Recently-built NICUs reap the benefits of improved sound insulation and design. Monitor alarms can now easily be transmitted visually. Intercoms can be replaced by wireless phones.
In any NICU, shift change discussions can be moved away from the bedside, and devices such as portable x-ray machines should be located as far from the baby as possible.

Good news has been reported by one study that observed the effects of implementing a “quiet period” in the NICU (reduced light, noise, staff activity, and infant handling). While there were some improvements in physiologic parameters, there was a significant difference in infant movement: only about 15 movements per hour were recorded versus 84 without a quiet period.\(^2\)

Staff members can do a lot to change the environment for their patients. For instance, they can keep conversations at a very low level, discourage loud noises such as laughing, and be careful not to place equipment (even small items such as pens) on top of the incubators. They should be very gentle when opening and closing portholes in the incubators and institute routine quiet periods.

**Light**

Little is known about the effects of light on small infants. However, there are studies that have shown damage to the structure and function of the retina in animals. There is also a randomized study by Raman demonstrating that sick and vulnerable infants exposed to normal light levels in the NICU may develop retinopathy of prematurity.\(^3\)

Continuous exposure to high intensity light and the lack of systematic and rhythmic diurnal dampening of light were noted to be a concern for normal development of premature infants even in early studies.\(^4\) However, there are additional factors that have been suggested relating to the very low birth weight (VLBW) infant that likely make the infant even more vulnerable. Some researchers suggest that the neonate’s eyes may not be completely closed and they may have increased pupil size due to decreased reactivity to light. Other researchers have measured levels of light intensity where peak levels were high enough to be in a range capable of suppressing melatonin.\(^5\)

On the other hand, premature infants that are placed in nurseries with dimmed lights are found to progress more quickly in their sleep-wake patterns, and showed similar improvement in sleep as well as diurnal variations in hormone and temperature levels.\(^6\)

In summary, there is enough concern and support from research materials about the biological effects of light in the NICU environment that changes must be put into place. Nurses are the ideal group to make the change, since they play a large part in making suitable accommodations such as covering incubators with a blanket and protecting baby’s eyes with shades when using phototherapy lights or other bright lights. Dimming lights during quiet time at night, while simultaneously following the noise reduction protocols, would also be beneficial for positive development.

**Manipulations and Procedures**

It is likely that NICU staff, from doctors to neonatal nurse practitioners, would agree that the premature infant is receiving a substantial amount of hands-on care. But how much is too much babies?

A study using a 24-hour surveillance camera in a university hospital NICU in Brazil revealed that infants underwent an excessive number of manipulations during 24 hours. Although many manipulations lasted less than a minute, they could be as frequent as one every 10 to 12 minutes, totaling an average of 2 hours, 26 minutes over a 24-hour period. This is especially staggering considering that the immature infant is extremely limited in its ability to adapt to the stress and stimulation of the extrauterine environment.\(^7\)

There are many opportunities to decrease interventions. Because bedside nurses are probably the strongest patient and family advocates, they’re the ideal members of the team to orchestrate the change. There are numerous examples of children having better outcomes when suctioning schedules are removed and handling is decreased to the absolute minimum. Not only do the infants do better in the short-term, with more autonomic stability such as fewer instances of apnea and bradycardia, but studies have documented a decrease in the number of intraventricular hemorrhages (IVHs).\(^9\)

**Heat and Cold Stress**

When stressed, the neonate responds by increasing the expenditure of energy – often at the expense of oxygenation. Whenever possible, nurses should support the infant with thermo-neutral protection during emergency resuscitations when other staff members are attending to life-saving interventions. Not only does hypothermia affect energy expenditure, but it also affects the integrity of surfactant and in the longer-term, weight gain.
Creating a less stressful environment

As mentioned above, studies have noted that certain types of beds and respiratory support systems are among the largest contributors of noise pollution, and I expect most people would agree with that. Therefore, it makes sense that manufacturers or neonatal equipment should be strongly encouraged to reduce the noise levels of their products. Newer incubators are designed to buffer external noise and operate more effectively to reduce the noise trauma.

Dräger is one of the leading manufacturers who have taken this issue seriously and have worked to provide highly advanced technologies that not only effectively decrease noise and light pollution, but also decrease temperature swings that could easily stress the baby physiologically. Dräger has made developmental care a top priority, and with this they will likely be successful in helping preemies get the best start in life during their care in the NICU.

About the author

Born in Mombasa, Kenya, Dr. Jane Scott attended the University of Western Australia Medical School in Perth at the age of sixteen. She subsequently lived in the Australian outback, England, Ireland, and the South African desert before moving to the United States, where she attended the University of Colorado Medical School and completed her residency in pediatrics and fellowship in neonatology at Duke University while simultaneously raising four young children.

After serving as a staff neonatologist at St. Joseph’s Hospital in Denver for six years, she led the effort to transition St. Luke’s Magic Valley Hospital NICU in Twin Falls, Idaho – the only NICU within a 120-mile radius – from a Level 1 to a Level 3A unit capable of treating many of the area’s smallest, sickest newborns.

Dr. Scott returned to Colorado in 2010 and practiced urgent care pediatrics in Centennial until December 2014. She is the inventor of the Tortle, an FDA-cleared infant repositioning device designed to prevent and eliminate flat head syndrome.

References

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