Anesthesia and Young Brains

CE 1.0 Contact Hour

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Abstract: Millions of children undergo anesthesia each year, and although some surgeries are medically necessary, the possible neurocognitive benefits of delaying elective surgeries in young pediatric patients need to be discussed between families and healthcare professionals as repeated or prolonged exposure to anesthesia in children less than 3 years old may negatively affect brain development. Nurses must be aware of the U.S. Food and Drug Administration recommendation and evolving research as they serve a key role in educating and supporting families through the perioperative process. This article discusses the recent U.S. Food and Drug Administration statement recommendations and its implications in clinical practice.

KEY WORDS: anesthesia, brain development, surgery

CASE STUDY

A 14-month-old boy with right equinovarus (club foot) and mild leg-length discrepancy is being seen with his caregivers for consultation on elective surgical repair. The otherwise healthy toddler has undergone serial casting and physical therapy since the second week of life. He has the ability to pull to stand and crawl and has been attempting to ambulate but continues to have obvious right foot inversion and forefoot rigidity. The caregivers have researched options for orthopedic surgery repair of the defect and have discussed the options with their pediatric provider. They feel that physical therapy has had limited value and no longer wish to continue casting of the foot.

History

The child was delivered full-term, normal spontaneous vaginal delivery, Apgars 7 and 9. He was discharged home with parents on Day 2 of life. He is up to date on vaccines, has no known allergies, and takes no medications. He lives with his parents and one older sibling who is healthy. His diet and elimination are normal, and he has met developmental milestones.

Examination

The child has normal vital signs; length, head circumference, and weight were all in the 60th percentile. During the examination, the infant appears vigorous and active by pulling up to stand, crawling, and scooting across the examination table. He is babbling and reaching for toys and attentive to both parents and the healthcare team. The physical examination is normal other than right foot inversion and forefoot rigidity (no cast or splint is currently being used), the left leg is measured one-fourth inch longer than the right. Pedal pulses are easily palpated; toes are warm to touch and mobile.

The surgeon and healthcare team conclude that the infant is healthy and will benefit from surgical correction of the foot deformity but suggest that the family continue splinting the foot and physical therapy treatment for another year. The family is noticeably discouraged by this recommendation and asks for clarification, stating that they understood surgery to be the treatment of choice for club foot when an infant began walking. The surgeon and registered nurse acknowledge that surgery will be needed but are recommending a delay in surgery based on the recently updated anesthesia guidelines for infants and young children and the fact that the child may need more than one surgery for orthopedic correction. After the detailed explanation, the family agrees to the treatment plan including continued physical therapy and return for follow-up with the surgical team in 6–9 months for reevaluation.

DISCUSSION

Although some pediatric surgeries are lifesaving therapies for infants with congenital heart or abdominal or neural tube defects and are vital in correcting acute conditions like testicular torsion or volvulus, elective surgeries to correct orthopedic and dermatologic conditions of infants and young children are safer if delayed until the affected child nears the age of 3 years, after neurodevelopment has progressed. After a review of extensive evidence, the U.S. Food and Drug Administration

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(FDA) recently released an official warning statement noting that repeated or long periods of exposure to general anesthetic and sedation drugs "may negatively affect brain development in children younger than 3 years" (FDA, 2017). The statement also included recommendations for pregnant women during their third trimester, which resulted in the labeling change of 11 common general anesthetic and sedation drugs used during surgical procedures for infants and children.

The warning is based on research studies conducted within the past 15 years, which showed, in animal studies, nervous system cell death and subsequent cognitive impairment after anesthetic exposure (Sanders, Hassell, Davidson, Robertson, & Ma, 2013), and led to significant concern for similar adverse effects in fetuses and young children exposed to these medicines. Although the clinical study results were varied and difficult to interpret due to a variety of factors including the type of surgery or underlying medical conditions such as prematurity (Andropoulos & Greene, 2017), results suggested that infants who experienced multiple exposures to anesthesia were at risk for learning disabilities later in childhood (Flick et al., 2011; Sanders et al., 2013; Wilder et al., 2009). More research is needed to clarify the effects of repeated or prolonged (>3 hours) anesthesia exposure in children, but until results are known, the FDA recommended that healthcare teams weigh the benefits of a surgery or procedure with both the known risks of surgery and the unknown neurocognitive risks related to anesthesia in young children (SmartTots, 2015)—when possible, delay exposure to anesthesia. Erring on the side of safety while promoting neurocognitive development may be appropriate for a child with an orthopedic concern like unilateral club foot who is thriving and growing well. It is interesting to note, however, that studies focusing on a single anesthesia exposure in infants and toddlers did not show significant negative effects on neurocognitive outcomes or behaviors (Davidson et al., 2016; Flick et al., 2011; Sun et al., 2016). When possible, performing multiple required surgical or procedural interventions under one anesthetic exposure could reduce the number of repeated exposures to anesthesia. However, it is unclear whether young children who undergo one prolonged exposure to anesthesia would experience greater neurocognitive benefits than undergoing multiple shorter exposures. The FDA warns against lengthy and repeated use of general anesthetic and sedation drugs, which raises the debate over a single, short use of anesthesia in children. If possible, the decision to delay an elective surgery can provide a safety net in the case of an unforeseen injury or diagnosis that may require a medically necessary operation, thereby reducing the risk of multiple exposures to anesthesia before the age of 3 years.

Nursing Implications

Healthcare providers may have been unaware of the significant risks and long-term neurological implications of anesthesia and sedation medication among young pediatric patients, especially in children's hospitals where surgery is routinely performed on infants and young children. The emerging research and the FDA official statement highlight developmental concerns and risks that need to be discussed with families during informed consent and consultation for elective surgeries. Information about what is known and unknown regarding long-term brain effects of anesthesia needs to be part of the preoperative discussion with the parents or caregivers. Consideration of surgical timing and duration is important because infants and toddlers' developing brains are especially vulnerable to effects of common anesthesia and sedation medications used during the perioperative period. Surgery for medically necessary and life-threatening conditions should not be delayed or avoided; however, elective procedures or surgeries that can be delayed until children are older warrant discussion between the family or caregiver and healthcare providers. Consequences of delaying procedures need to be a focus of the deliberation.

Nurses play a key role in the perioperative process and are instrumental in educating parents and adult caregivers of infants and young children as well as providing support and counseling. In addition to completing a thorough history and physical assessment, pediatric perioperative nurses address anxieties of the patients and family members (Derieg, 2016). Surgical planning and preparation can be a particularly stressful time for families, and being informed of these recent anesthesia guidelines will help nurses best educate and support families. Although current nursing postoperative management focuses on "addressing airway, vital signs, pain assessment and management, fluid management, and preparation for discharge" (Derieg, 2016), the support and education nurses provide to families as they plan for postoperative care are also important. In the future, assessments in the hospital or during follow-up visits may include more detailed neuro and cognitive-related assessment protocols for pediatric patients who underwent anesthesia as infants or toddlers. These may include standardized developmental tests being conducted more frequently among children who were exposed to anesthesia, prompting developmental referrals for any children with delays who underwent surgical interventions and discussion of parenting strategies, which promote growth and development.

CONCLUSION

Recent guidelines released by the FDA state that there may be negative, long-term neurological effects associated with repeated or prolonged use of anesthesia in children less than 3 years old. The statement sparks a discussion between families, nurses, and other healthcare professionals when weighing the risks and benefits of the use of anesthesia in young children.

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