

Imaging in the Newborn: Infant Immobilizer Obviates the Need for Anesthesia

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ABSTRACT: **Background:** Neonatal cerebral imaging is a sensitive technique for evaluating brain injury in the neonatal period. When performing computed tomography or magnetic resonance imaging, sedation is needed to prevent motion artifacts. However, general anesthesia in neonates carries significant risks and requires a complex logistic approach that often limits the use of these modalities. The development of infant immobilizers now enables imaging without general anesthesia and significantly increases clinical and research investigational opportunities.

Objectives: To assess the efficacy of the infant immobilizer instead of general anesthesia for infants undergoing imaging.

Methods: The study group comprised all infants born over a 1 year period at Soroka University Medical Center who required imaging such as MRI, CT or bone scans. A MedVac Vacuum Splint infant immobilizer was used in all infants to prevent motion during imaging. The success rate of a single scan and the need for general anesthesia were assessed.

Results: Forty infants were examined during 1 year. The studies included 15 CT scans, 25 MRIs and 1 bone scan. The infants' gestational age at birth was 27–40 weeks and the examinations were performed at ages ranging from delivery to 6 months old. All imaging was successful and none of the infants required general anesthesia.

Conclusions: An infant immobilizer should be used for imaging of newborns. Since this method carries a low risk and has a high success rate, general anesthesia in newborns is justified only when this non-invasive procedure fails.

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KEY WORDS: general anesthesia, brain imaging, newborn, immobilizer

For infants in the neonatal intensive care unit, complex diagnostic procedures are often needed to complete the clinical workup. Imaging is an integral part of this workup. The most widely used modalities are magnetic resonance imaging and computed tomography. Motion artifacts affect the quality of the examination and, as a result, also the ability to correctly interpret the test. In order to overcome this problem infants are sedated or anesthetized for these procedures. Sedation may be mild using benzodiazepine, or deep using agents such as

propofol [1-5]. However, the safety profile of these drugs for infants is unclear [6-9], and since their use carries significant risks the presence of an anesthetist is required [2].

Anesthesia increases the risk for the infant, adds to the cost and limits the duration of the procedure. The sedated baby will require not only close monitoring during the procedure but also a period of recovery that involves beds, monitoring and qualified personnel. Sedation exposes the fragile and sick neonate to additional stress and risk. Furthermore, in most medical centers, each with its already exhausted anesthesiology unit, for an anesthetist to be present often necessitates complex logistics and coordination mainly due to the shortage of anesthetists [10]. Although the scientific value of many imaging techniques has been proven [11-15], risk versus benefit ratios are considered before using these modalities and decision-making is significantly affected by the risks involved [16,17]. We report here on the efficacy of an immobilizing device that prevents motion during imaging and eliminates the need for general anesthesia.

PATIENTS AND METHODS

Included in this report are all term infants who underwent imaging procedures (MRI, CT, nuclear scan) at our institution during a 12 month period. Prior to placing the infant in the device, the infant was fed and the diaper changed. Both ventilated and non-ventilated infants were included in this study. All infants were monitored during both transport to the imaging department and the imaging itself.

THE DEVICE

The immobilizing device used, the CFI MedVac vacuum splint (Fenton, MI, USA), consists of an air-tight chambered bag filled with tiny, evenly spaced polyester beads. The bag is wrapped around the infant's body. The infant is secured with belts around the head and body before being transported to the imaging department. Immediately before the procedure, the air is evacuated from the bag with a manual vacuum pump until it becomes rigid. The deflated bag follows the contours of the infant without exerting any pressure on the body. Once the procedure is completed air is allowed to reenter the bag, softening it and allowing removal of the infant.

Infants were fed prior to positioning in the bag, and a pacifier with or without sucrose was given if needed during the procedure. The device is easily cleaned with alcohol-based disinfectants after each application.

RESULTS

Forty infants are included in this report, representing all imaging performed in the 12 month period of data collection. CT scan was performed in 15 infants, MRI in 24, and a bone nuclear scan in 1 infant. The infants' gestational age at birth was 27–42 weeks, and the examinations were performed at ages ranging from delivery to 6 months old and at weight 1900–5500 g [Table 1]. Two of the infants were on ventilatory support due to preexisting clinical indications. Table 2 shows the indications for imaging.

The infants were accompanied by a senior pediatric resident, a neonatal fellow, a neonatal nurse or certified neonatologist. As cuddling is the key to the successful use of the device, parents were strongly advised to join the neonatal team. No further sedation was needed during the procedures and all images obtained were considered qualitatively appropriate for interpretation by the radiologist on service [Table 3]. There was

no need to interrupt scanning for any additional repositioning or cuddling of the infant; therefore, the scanning time was no different than expected. Since there was no need for preparation for general anesthesia or for stabilization of the infant prior to the scan, both the overall time spent by the multidisciplinary team and the scanning time were significantly shorter.

DISCUSSION

We report on 40 infants who needed an imaging procedure. Prior to the introduction of the immobilizing device in our unit, most of these infants would have been sedated or anesthetized and intubated for these procedures. This technique is safe, of low cost and reduces the workload in the anesthesiology department. The only limitations when using this device is that the infant must be calm; this can be achieved by cuddling or feeding that usually takes a few minutes. Another limitation is that the infant be positioned correctly. The postnatal age and the weight of the infant are not limiting factors.

Reducing the risk of anesthesia during imaging of the infant will lead to less reluctance of the neonatal team to conduct imaging and will place CT but mostly MRI among the more accessible diagnostic tests in neonates. The development of non-invasive easy to perform procedures, such as portable ultrasounds and bedside continuous amplitude integrated electroencephalography, has been a huge stride in enhancing our understanding of neonatal pathologies. Now with the significant reduction in risk, MRI can be added to the list of these non-invasive investigations. Terri Inder and her group [18] have published several important studies on the use of an infant immobilizer and without general anesthesia, emphasizing that in experienced hands these techniques are applicable and should become part of the routine neurologic examination of the newborn. The information and the sensitivity of these procedures are invaluable in the evaluation of infants with a potential abnormal neurologic condition. Immobilizing is only a part of the preparation of an infant to ensure the final result of good quality imaging. Adequate preparation includes temperature control, soft blankets, timing of feeds, a skilled neonatal nurse accustomed to handling infants and the presetting of scanners to minimize scanning time [18]. In summary, general anesthesia is not justified in neonates who can be calmed and put to sleep by swaddling and simple non-invasive immobilization. Despite the high success rate of this technique as reported in this article, some infants will fail the procedure and will still need general anesthesia but this should be considered only after failure using the immobilizing device. This report is aimed at clinicians, who should advocate this procedure to reduce investigational risks for the benefit of their patients. Radiologists require good quality imaging and it seems that this can be provided without the risks of general anesthesia.

Table 1. Baseline characteristics of the study group

Total no. of scanned infants	40
Gestational age at birth	27–40 wks
Age at the time of examination	Birth to 6 months
Weight at the time of examination	1900–5500 g

Table 2. Indication for imaging

Indication for imaging	No. of infants
Hypoxic ischemic encephalopathy	10
Focal seizures	8
Congenital microphthalmia	2
Meningomyelocele	1
Post-hemorrhagic hydrocephalus Intraventricular hemorrhage Periventricular leukomalacia	8
Microcephaly	6
Repeated lung atelectasis	1
Head trauma	4

Table 3. Results of imaging without anesthesia

Total no. of scans	40
CT	15
MRI	24
Bone scans	1
Success rate	100%

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