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Sedation and anesthesia for magnetic resonance imaging in pediatric patients: is dexmedetomidine the answer?

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We reviewed the current state of knowledge regarding pediatric sedation mainly for nonpainful procedures, such as MRI studies. The increasing number of requests for pediatric sedation has triggered intense research for finding various solutions that would enable the safe administration of sedation by nonanesthesiologist physicians, supervised trained nursing personnel (CRNAs and/or RNs), or sedation teams combining different provider types. We also reviewed the current data on the use of dexmedetomidine in children, as a sedative agent in the MRI suite. Dexmedetomidine is an excellent sedative, has analgesic properties, and appears to be clinically safe from a respiratory point of view even at high doses, although instances of bradycardia and hypotension have been reported. Dexmedetomidine appears to be a promising option for sedation in the pediatric population in the MRI setting.

The indications for magnetic resonance imaging (MRI) have increased steadily over the years. In 2004, the National Electrical Manufacturers Association (NEMA,http://www.NEMA.org) estimated that 9704 MRI units were available in the US. This large number of available MRI machines has made it easier to refer patients for diagnostic scans, and the requests are continuously increasing in number. At Children's Medical Center at Dallas, Texas, the number of requests for anesthesia/sedation for MRI has increased over 200% in the last 2 years (from 1078 cases in 2005 to 2557 cases in 2006). In other centers with long-standing sedation services, the increase is not so impressive.[1] Whereas both the number of MRI units and the number of MRI exams have increased in recent years, some of the technological constraints have remained the same.

For the MRI study to be successful, patients have to remain still inside a hollow, noisy, and cold tube within the machine. Patients who require sedation/anesthesia for an MRI scan consist of two groups: a small number of adults (due to claustrophobia, back pain, tremor, etc.)[2] and the majority of pediatric patients. For MRI patients receiving sedation, the pediatric population represents the subgroup with the highest risk and the lowest error tolerance, especially when care is provided by inexperienced sedation providers.[3,4]

The goal of this article is to review the current knowl-

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edge in the field of MRI pediatric sedation, inclusive of a promising new drug: dexmedetomidine.

Sedation/anesthesia providers for MRI scans

Historically, pediatric radiologists have administered their own sedation using relaxation techniques or medications such as chloral hydrate.[5,6] Other sedation medications, such as phenobarbital, fentanyl, midazolam, and ketamine,[7] have also been used by both sedation-trained nurses and physicians. However, when traditional sedation techniques have failed, pediatric anesthesiologists have been consulted and have become more involved in providing sedation/anesthesia for radiological studies, as well as in developing sedation and anesthesia protocols for infants.[8]

During the past two decades, the involvement of anesthesiologists in the MRI suite has evolved into a distinct anesthesia subspecialty that has a unique skill set, a growing number of indications, and expanding practice locations.[9]

However, in centers where anesthesiologists are not readily available, some sedation services are directed by trained nursing personnel.[10-12] Others have developed the concept of a sedation room or a sedation team combining different provider types.[13-17]

Conflicting sedation guidelines and medicolegal aspects

British guidelines disagree with the use of deep sedation by non-anesthesiologists,[18,19] but these guidelines mainly refer to the adult sedation. Despite this, and without reference to pediatric opinion, the Royal College of Surgeons of Edinburgh[19] in 1993 stated: "Intravenous sedation is hazardous in children as the therapeutic margin between sedation and anesthesia is very narrow. In view of this, sedation should be administered only under very special circumstances."

The report of the National Confidential Enquiry into Perioperative Deaths (NCEPOD)[20] in 2000 provided evidence for sedation problems in radiology in the UK. This report stated that the gold standard monitoring during interventional vascular procedures should include pulse oximetry, blood pressure measurements, and electrocardiography. In addition, someone other than the radiologist should be responsible for monitoring the patient during the procedure. A total of 303 deaths were identified during the period surveyed. Of the patients that died, 19 were not monitored at all, 60 did not have pulse oximetry monitoring, and 40 did not have their blood pressure measured. Sixteen patients died while being monitored by a radiography technician, and 97 died while being monitored by the interventional radiologist alone.

British pediatric anesthesiologists are opponents of deep sedation by non-anesthesiologists, but do not have objective evidence to unequivocally support their position.[21]

Nevertheless, whereas it is impossible for anesthesiologists to provide sedation for all radiological studies and imaging procedures, it is possible for anesthesiologists to have a key advisory role in establishing the safeguards and protocols that would ensure individual and public safety.[22]

In a recent controversy regarding sedation versus general anesthesia for MRI in children, Bray[23] and Davis and coworkers[24] argued that general anesthesia is safer and more reliable for management of children undergoing MRI scanning, even though deep sedation may possibly produce satisfactory conditions for the scanning. In this paper they state: "Just because something is possible does not mean that it is best practice, and that is what we should be providing for our children."

From a complications standpoint, it is not known whether general anesthesia or deep sedation for MRI scans are equal in safety, or if one is superior to the other. Lawson[21] and Sury and coworkers[25] argue in favor of allowing deep sedation for MRI and other procedures (providing that the existing guidelines are implemented) until a national British inquiry will determine the relative risk of deep sedation versus general anesthesia.

In the US, pediatric guidelines were published by the American Academy of Pediatrics in 1985[26] and revised in 1992.[27] These guidelines state that deep sedation in children is an acceptable end point and that it is not mandatory that deep sedation be supervised by an anesthesiologist. These conclusions were reinforced by the Joint Commission on Accreditation of Healthcare Organization's recommendations that went into effect on January 1, 2001 and emphasized the need for adequate patient observation and monitoring. The Joint Commission also pointed out the crucial importance of acquisition of appropriate skills by the providers of sedation, including skills in rescuing the patient whenever it becomes necessary.[28]

Contrary to these recommendations, Freeman and Vining[29] contend that sedation alone for a nonpainful procedure such as an electroencephalogram (or MRI) is inherently safe, and that the use of chloral hydrate alone in such cases does not warrant any monitoring or attendance by qualified medical personnel. They justify their stand on the grounds that it is fiscally unsound to subsidize a nurse to monitor each child and that cost is always a consideration. While accentuating the need for enhanced safety of sedated children, Malvyia and coworkers[30] and Cote[31] argue that it is morally irresponsible not to monitor each child and, if this cannot be done in a certain institution, it is ethical to advise the patients and their families to undergo the procedure elsewhere.

Sedation/anesthesia and safety

During the last 15 years, a series of studies showed a wide range of serious adverse events to sedation, including upper airway obstruction, hypoxemia, and even death.[3] And al-