

TITLE: DISCHARGE HOME IN THIRTY MINUTES FOLLOWING SEVOFLURANE ANESTHESIA FOR PEDIATRIC OUTPATIENT IMAGING-CAN IT GET ANY BETTER?

AUTHORS: HEBBAR L, OVERDYK FJ, TOBIN DP

INSTITUTION: DEPARTMENT OF ANESTHESIA AND PERIOPERATIVE MEDICINE, MEDICAL UNIVERSITY OF SOUTH CAROLINA, CHARLESTON, SC, USA

ABSTRACT

Introduction: The optimal management of pediatric patients for the acquisition of good quality diagnostic imaging has been widely debated. Previous studies have examined both the advantages and adverse effects of general anesthesia versus sedation for this procedure. The advantages of performing pediatric imaging under general anesthesia as opposed to sedation include a quick onset, lack of failure due to patient movement and less incidence of respiratory events¹. However, no previous study has analyzed the speed of recovery following general anesthesia, which directly impacts efficiency of the MRI suite, patient cost and parental satisfaction. We therefore decided to study recovery and discharge times following sevoflurane anesthesia in our pediatric population for outpatient imaging procedures.

Methods: Sixty-five pediatric patients (ages=2 months to eight years) scheduled for outpatient MRI/CT were included in the study. None of the patients received any premedications. Induction of anesthesia with nitrous-oxide/oxygen and sevoflurane was performed with parental presence in the designated anesthesia induction room. Airway was secured with a LMA (n=60) or endotracheal tube (n=5) as considered appropriate. Anesthesia was maintained with sevoflurane (average end-tidal 2.3%) in oxygen. The following times were noted: discontinuation of sevoflurane, return to baseline level of consciousness, oral intake and discharge home.

Results: Following discontinuation of sevoflurane the documented times expressed as mean \pm standard error in minutes were: average time to return to baseline level of consciousness was 10.78 ± 0.56 , time to oral intake was 16.48 ± 1.07 and discharge home was 30.01 ± 1.26 .

Discussion: In the past, the management of diagnostic imaging procedures in pediatric population was performed routinely under sedation by non-anesthesiologists. The increased incidence of failure rate due to patient movement, inadequate sedation, adverse respiratory events, residual sedation and adverse respiratory events after discharge resulted in a recent increase in the involvement of anesthesia providers to aid diagnostic procedures in this patient group. There are several options for the anesthetic providers to aid diagnostic procedures in this patient group. There are several options for the anesthetic management of these cases including the use of total intravenous or inhalational agents. The use of general anesthesia for pediatric imaging has been viewed in the past as costly, associated with high risk and inefficient². Our current study has shown that this is not the case. The physical properties of sevoflurane facilitated a rapid, smooth induction and placement of an intravenous access after induction, both of which were appreciated by the parents. The quick recovery and discharge time was appreciated both by the radiology department and the concerned parents. We therefore conclude that sevoflurane anesthesia is cost-effective and optimal for pediatric outpatient imaging because of the non-existent failure rate, minimal adverse effects, and above all the speed of recovery and discharge.

BACKGROUND

With technological advances in the field of imaging, the number of diagnostic and therapeutic procedures done outside the operating room has increased over the last decade. In the pediatric population, this involves provision of some modality of 'pharmacological immobility' be it sedation or general anesthesia.

Practice at our Institution: Prior to 2000, the nursing personnel in the Radiology Department were responsible for both administration and monitoring of pediatric sedation under the supervision of the radiologist. A high failure rate, adverse respiratory events, cardiac arrests and discomfort of the radiologist who with little or no training was functioning as an anesthesiologist, prompted the decision to involve the Department of Anesthesia in all pediatric MRI/CT scans. Since 2000, we have performed over 5000 pediatric anesthetics. Our current anesthesia practice evolved from deep sedation, which we abandoned due to a high failure rate and unpredictable recovery profile. We noticed that patients who had general anesthesia were discharged from the recovery room in a time frame comparable or even shorter than the sedation cases. Since, no literature has looked at recovery characteristics following sevoflurane anesthesia, we decided to look at recovery and discharge time profile of pediatric patients following diagnostic imaging under sevoflurane anesthesia.

METHODS

We looked at the recovery and discharge profile of 65 consecutive ambulatory pediatric patients presenting for MRI/CT imaging. *Pre-anesthesia evaluation* performed by the anesthesia provider on the day of the scan i.e NPO status, focused physical examination and an informed consent obtained by anesthesiologist. *Anesthetic induction* was performed as follows: Patients were induced in designated anesthetic induction room adjacent to the MRI suite and patients for the CT scan are anesthetized in the scanner. No premedication was administered to any of the patients. All patients were induced in the presence of parents. The induction room is provided with an anesthesia machine, piped oxygen, nitrous oxide, air and vacuum. Children induced on MRI compatible stretchers with parental presence. Monitors during induction include pulse oximetry, 4-lead EKG using MRI compatible EKG electrodes, non-invasive blood pressure and end-tidal carbon-di-oxide. Inhalational induction was performed with nitrous-oxide/oxygen/sevoflurane (5-8%). If the child had intravenous access, then an intravenous induction was performed with propofol (1-2mg/kg). Intravenous access was established after induction. Airway was secured (depending on patients age and co-existing medical conditions) with either LMA (n=60) or endotracheal tube (n=5). The indications for endotracheal intubation included age (<6 months of age) and types of scan (CT chest and abdomen with oral contrast). Muscle relaxants were not used for LMA placement or endotracheal tube placement. Deep sevoflurane anesthesia (en-tidal sevoflurane > 5%) was used for successful intubation. Patients were disconnected from anesthesia circuit and monitors, ambu-bagged to the MRI scanner on stretcher. *Anesthetic maintenance:* The MRI room is provided with an MRI compatible anesthesia machine piped with oxygen, air, vacuum, back-up oxygen cylinders and MRI compatible laryngoscopes. Monitors include: MRI compatible pulse oximetry, 4-lead EKG, non-

invasive blood pressure, end-tidal carbon-di-oxide using the Invivo Millenia 3155 MVS monitor. Ventilation was either spontaneous or controlled (depending on patients age and co-existing medical and airway management by non-anesthesiologists. Some of the advantages of an anesthesiologist run service are:

1. EFFICIENCY AND COST REDUCTION

The use of general anesthesia to aid therapeutic and diagnostic imaging has been perceived as expensive, associated with considerable risk and inefficient². Performing these procedures under deep sedation can be costly in terms of quality of scan, increased personnel time, variability in onset of sedative action resulting in downtime of the scanner, lost revenue from failed procedures, inconvenience to patients and families, legal settlement with adverse events related to sedation by non-anesthesiologists, variable recovery kinetics and delayed diagnosis if the case requires to be rescheduled. The latter can have a major clinical impact on outcome. Indeed Malviya et al had a 29% incidence of poor quality scans in sedated patients, which resulted in a significant loss of revenue to the hospital¹.

2. RELIABILITY

The reliability of using general anesthesia for the purpose of achieving immobility is 100% reliable. As our study has shown, there was no repeated imaging due to patient movement under general anesthesia.

3. RAPIDITY OF TURNOVER

The fact that imaging is a non-invasive, painless procedure it is possible to maintain anesthesia at a lighter rate plane. The physico-chemical properties of sevoflurane facilitate a very rapid and smooth induction and emergence. Parental presence in lieu of pharmacological premedication also facilitated a rapid emergence.

4. RECOVERY PROFILE

The kinetics of recovery and discharge time following general anesthesia has not been addressed in past studies especially with the use of sevoflurane. Malviya et al in their study on adverse events and outcome following general anesthesia for MRI/CT imaging used in isoflurane as their agent. Documented recovery times were 70 ± 11.5 minutes and 59.9 ± 36.9 minutes following MRI and CT procedures respectively. However, there was no comment on discharge time. The only published data with discharge time following general anesthesia is from Burke and Pollock³. In their study, general anesthesia was induced and maintained with propofol. Reported discharge time in these patients was documented as 2-3 hours following the end of the imaging process. In our current study, the anesthetic technique of inducing and maintaining with sevoflurane in oxygen, provided a superior discharge time of 30 mins.

5. SAFETY

Our study has clearly demonstrated that general anesthesia is indeed a safe alternative, probably a safer option in some pediatric patients to facilitate MRI and CT scans. Safety would be a decisive factor in favor of general anesthesia.

ADVERSE EVENTS

There has been no study, which has reviewed adverse events, related to anesthesia in the pediatric population during imaging process; there is no data available in current literature to determine whether it is safer than deep sedation. Of great concern would be respiratory related events especially laryngospasm on emergence and during transport to

the PACU. However, in our study, we had no adverse cardiovascular or respiratory conditions. All of our patients with LMA's breathed spontaneously throughout the procedure using the Datex Ohmeda Aestiva 5 MRI compatible anesthesia machine. Sevoflurane/oxygen/air was used to maintain the anesthetic. The average end-tidal sevoflurane provider tele-monitored the patient through a glass window just outside the scanner. The CRNA remained in the scanner, if the patient is ASA III and above. Intravenous fluids were administered during the procedure. *Emergence*: Patients were awakened and extubated (ETT or LMA) after the procedure in the MRI room and transported on stretcher to the adjacent recovery area. *Recovery*: Patients were monitored with pulse oximetry, non-invasive blood pressure and EKG is indicated. Patients were discharged from the recovery room when the American Academy of Pediatrics (AAP) discharge criteria was met. All outpatients were given written post-anesthesia instruction sheet that included activity instructions as well as resource phone numbers.

RESULTS

Following discontinuation of sevoflurane the following time were documented: average time to return to baseline level of consciousness, time to oral intake and time to discharge home. The results are shown in Table 1

TABLE 1. Duration in minutes of the stages of recovery following discontinuation of sevoflurane (Mean \pm SEM)

Recovery Time Points	
Return to baseline level of consciousness	10.78 \pm 0.56
Time to oral intake	16.48 \pm 1.07
Time to discharge home	30.01 \pm 1.26

There were no adverse events during the anesthetic induction, maintenance and emergence. However, during recovery in the PACU we had some episodes of irritability (n=5) and nausea/vomiting (n=2).

DISCUSSION

Pediatric patients for imaging are referred from a wide spectrum of sources. The choice of whether a non-anesthesiologist or a qualified provider should perform sedation is institutional dependant. In institutions where sedation for imaging is performed by both non-anesthesiologists and anesthesiologists, there are often very arbitrary guidelines for patient selection to either group. ASAIII status patients and above are designated for care by anesthesiologists and the decision is made either by the referring physician or the radiologist. The lacuna with this system of scheduling cases without anesthesia input is that patients with potentially difficult airway i.e. Pierre Robin Syndrome may be referred for sedation by a non-anesthesiologist. This can lead to cancellations and/or sometimes dangerous situations, which can compromise patient care and result in adverse outcomes. With all pediatric cases begin referred for care to an anesthesiologist run service, such situations can be circumvented.

Anesthesiologist versus non-anesthesiologists for the optimal and safe care of pediatric patients for imaging is an ongoing debate. Currently we have no recommendations/guidelines from the ASA for determining competency in deep sedation

event. The only adverse events were unaccountable irritability in 5 patients and nausea and vomiting in 2 patients.

DISADVANTAGE: the disadvantages with the GA include the need for dedicated anesthesia equipment and a greater availability of pediatric anesthesiologists. Also, a theoretical disadvantage would be that there could be considerable delays in accessibility to scanning due to the waiting period due to anesthetic requirements. This may lead to an adverse outcome, which might have been avoided by a more timely investigation done under sedation.

CONCLUSION: Our data demonstrates that the general anesthesia for children for MRI and CT is a very safe alternative. It is not associated with risks of hypoxemia and a zero failure rate as a result of cancellation due to poor film quality. One of the greatest advantages was the rapid emergence and the time back to baseline activity which facilitated a rapid discharge from the hospital. This predictable advantage was appreciated by all members involved with the patient's care, parents who were ecstatic about being an active participant in their child's care and a short hospital visit, radiology department since it was possible to schedule more cases due to the shorter discharge time and of course members of the anesthesia team.

Reference:

¹ BJA 2000; 84 (6): 743-748

² Gastrointest.Endosc 1995; 41: 99-104

³ Anaesthesia 1994; 49(7) 647