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Procedural Sedation for Pediatric Patients: Retrospective Comparison of Intravenous Deep Sedation and General Anesthesia: Research Report

Basnet S[1]*, Nicolas L[2] and Koirala J[1]

1 Department of Pediatrics, Division of Critical care, Southern Illinois University School of Medicine, Springfield, Illinois, USA

2 University of Florida, Gainesville, Florida, USA

***Corresponding author:** Basnet S

sbasnet@siumed.edu

Associate Professor, Department of Pediatrics, Division of Critical care, Southern Illinois University School of Medicine, St John's Children's Hospital, 415 N. 9th Street, Suite 4W64, PO Box 19676, Springfield, IL 62794, USA.

Tel: 217-757-6655

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Abstract

Background: Pediatric patients may require sedation for prolonged imaging studies and painful procedures outside the operating room. Such procedures may be done under intravenous deep sedation or general anesthesia.

Aim: This study compares the cost and recovery time between intravenous deep sedation and general anesthesia for such procedures.

Method: A retrospective chart review comparing the use of intravenous deep sedation and general anesthesia for procedural sedation was conducted for children under 18 years old undergoing outpatient sedation for magnetic resonance imaging.

Results: Out of 157 procedures, 94 received general anesthesia with sevoflurane (60%) and 63 (40%) intravenous deep sedation with propofol. Only one complication occurred. Age and body weight were similar in both groups. Cost of sedation for general anesthesia (mean $1712; 95% confidence interval, 1611-1812) was higher than for intravenous deep sedation (mean $674; 95% confidence interval, 556-793), p<0.001. Similarly post sedation recovery time (mean 56 min; 95% confidence interval, 49-63) was higher with general anesthesia than intravenous deep sedation (mean 37 min; confidence interval, 32-42), p<0.001. The results did not change after controlling for American Society of Anesthesiologists Physical Status (ASA) grade and duration of sedation.There was no reason given for scheduling to general anesthesia on 60% of cases, and 19% were scheduled just for the convenience of choice of day.

Conclusions: Cost to patient and time to discharge post sedation may be lower with intravenous deep sedation as compared to general anesthesia. Therefore, protocols to correctly triage patients based on risk of airway compromise may be important.

Keywords: Pediatrics; Procedural sedation; magnetic resonance imaging; cost; recovery time; triage

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Introduction

Pediatric procedural sedation (PPS) outside the operating room has become increasingly routine [1]. Traditionally anesthesiologists were the sole providers of all procedural sedations/anesthesia within a hospital, however, as a consequence of its rapid growth; anesthesiologists alone could not meet the demand [2]. This led to non-anesthesiologists providing this service. Procedural sedation outside the operating room can be performed under general anesthesia (GA) or intravenous deep sedation (IVS) depending on the risk of airway compromise and need for airway control. However, there is very little data in published literature comparing IVS vs. GA in non-operating room/non pediatric intensive care unit areas.

The aim of this study was to determine the cost and recovery time differences that may occur with IVS vs. GA for magnetic resonance imaging (MRI) within an organized procedural sedation service.

Patients and Methods

After approval from Springfield Committee for Research Involving Human Subjects (local Institutional Review Board), a retrospective chart review was conducted of patients undergoing outpatient sedation for MRI at St. John's Children's Hospital between May 2010 and May 2011. Children needing MRI for various reasons and requiring sedation/anesthesia (to prevent movement that would result in poor quality imaging) were included in the study. All patients that were already hospitalized (in-patients) were excluded. The cost of sedation was the amount the patient was charged. We received this data from the hospital billing department. MRI procedure cost was not included since these would be the same for procedure per unit time. Provider billing (for GA and deep sedation with IVS) was also not included. The American Society of Anesthesiologists Physical Status, ASA, are the grades as described by the American society of Anesthesiologists [3]. The recovery time is the time from end of sedation to discharge. Complications were defined as aspiration, death, cardiac arrest, unplanned admission to the hospital, and unplanned endotracheal intubation or an increase in a patient's level of care, or emergency anesthesia consultation [4].

Pediatric sedation service

St John's Children's Hospital sedation team comprised of anesthesiologists, pediatric intensivists and 2 sedation nurses. The sedation program was structured in compliance with the guidelines developed by the American Academy of Pediatrics [5,6] Committee on Drugs and the American Society of Anesthesiologists [7]. All calls from physician offices or parents/guardians were received by hospital scheduling staff (non-clinical) who scheduled patients for the procedure either on Tuesdays or Thursdays. The scheduling staff also provided instructions on when the child should stop taking oral food or drink. A current history and physical was required from the primary care physician's office. Patients scheduled on Tuesdays received GA and those scheduled on Thursdays received IVS. The aim was to achieve a depth of at least deep sedation or anesthesia [5] so as to keep the child immobile for successful completion of the MRI. After completion of the procedure, the drugs were discontinued and patient was monitored in the adjacent recovery room until discharge criteria were met [8].

Data Collection and Statistical Analysis

Data collection included patient's age, weight, gestational age, list of medications, surgeries, medical problems, patient or family history of anesthesia problems, NPO status, drugs used, depth of sedation (GA vs. IVS), reason for triaging to GA, sedation cost, duration of sedation, recovery time, complications, sedation score, and ASA grade. Simple descriptive statistics was used to define various observations including means and confidence intervals (CI). Further statistical analyses included univariate ANOVA for continuous variables, Mann-Whitney U test for categorical variables, and multivariate regression analysis. Comparison of cost of sedation and recovery time after controlling for length of sedation and ASA grade was done between the two groups (GA and IVS). Level of significance was defined as 0.05. SPSS statistical software was used for data analysis.

Results

One hundred and fifty seven sedations were performed for MRI studies in the one year period, 94 were GA (60%) and 63 (40%) were IVS. Age and weight were similar between the two groups (**Table 1**). There was no statistical difference between the number of history and physical forms received from the referral physician office, 91% for GA vs. 93% for IVS (p>0.05). Sevoflurane was used for all procedures under GA with either laryngeal mask airways (LMA) or endotracheal intubation whereas propofol was used for all procedures with IVS.

Cost of sedation was significantly greater with GA vs. IVS (mean $1712 vs. $674 respectively, p<0.001) (**Table 2**). Duration of sedation (89 vs. 55 min respectively) and ASA grade (2.1 vs. 1.4 respectively) were both higher in the GA group as compared to the IVS group (p<0.001) (**Table 1**). Out of 94 GA cases, 21 were ASA grade 1 and 56 ASA grade 2. Post sedation recovery time was significantly longer for GA as compared to IVS, (56 vs. 37 minutes, respectively, p<0.001) (**Table 2**).

The difference in cost of sedation in USD was still significant after controlling for duration of sedation in minutes (p<0.001) and ASA grade (p<0.001). Similarly the difference in recovery time in minutes was still significant after controlling for duration of sedation time in minutes (p<0.001) and ASA grade (p<0.001). There was no data available on the reason to triage to GA for over 60% of procedures (**Table 3**). Where data was available, 19% were triaged to GA because of the convenience for choice of day and almost 19% for duration of procedure of over 2 hours.

Only one complication that was significant occurred in a child with cerebral palsy and laryngomalacia in the GA group: stridor requiring admission to the hospital.

Table 1: Baseline data.

Baseline	General anesthesia, n=94 mean (95% CI)	Intravenous deep sedation, n=63 mean (95% CI)	p-value (significance)
Age (months)	50.6 (33.6-67.6)	45.5 (29.8-61.1)	0.85 (NS*)
Weight (kg)	21.5 (14.0-28.9)	18.7 (13.6-23.8)	0.76 (NS*)
Total sedation duration (min)	89 (76-101)	55 (48-63)	< 0.001
ASA grade	2.1 (1.9-2.3)	1.4 (1.2-1.6)	< 0.001
*not significant			

Table 2: Outcome data.

Outcomes	General anesthesia, n=94 mean (95% CI)	Intravenous deep sedation, n=63 mean (95% CI)	p-value (significance)
Cost of sedation (USD)	1712 (1611-1812)	675 (556-793)	<0.001
Post sedation recovery time (min)	56 (49-63)	37 (32-42)	<0.001

Table 3: Reason for triaging to either general anesthesia vs. Intravenous deep sedation.

Reason for general anesthesia	Frequency n=157 (%)
Age	8 (5.1)
Duration of procedure	29 (18.5)
Obesity	3 (1.9)
Medical condition	21 (13.4)
Past sedation complications	3 (1.9)
Schedule	30 (19.1)
Data unavailable	63 (40.1)

Discussion

The past decade has seen a welcome paradigm shift from minimal sedation and forceful restraint for painful procedures and prolonged diagnostic imaging, to pediatric procedural sedation (PPS). PPS may be done under either GA or IVS. Reports from the Pediatric Sedation Research Consortium confirm that PPS performed outside the operating room is safe [4,9].

To our knowledge, our study is the first to describe the difference between cost to patient and recovery time between GA (outside the operating room) and IVS for MRI studies. There is one study by Shiley et al. in 2003 that compared safety and cost between GA vs IVS for pediatric otolaryngology procedures [10]. The providers in this study were anesthesiologists and the procedures under GA were performed only in the operating room. Our study shows that both overall cost and sedation cost to the patient are significantly higher with GA, even when done outside the operating room, as compared to IVS. Additionally, both cost and the total recovery time remained higher in the GA group even after controlling for ASA status and length of procedure. Therefore, it may lead to cost and time saving if patients who need PPS but are not at high risk of airway compromise receive IVS, not GA with airway control. In our study there was no formal triaging tool and system in place to distinguish at-risk patients: which may have led to patients receiving GA when they could have completed the procedure with just IVS.

Having said that, there are those occasional at-risk patients with increased probability of airway compromise who may need airway protection and endotracheal intubation or laryngeal mask airways [11]. Therefore, since the completion of this study, we have created a triaging tool that sedation nurses utilize to appropriately triage patients needing deep sedation based on risk of airway compromise.

The most notable limitation of our study is its retrospective design. The cost comparison was done on actual hospital billing to patients, mainly for drugs, equipment, and nurse time. We did not include MRI cost and physician billing. A cost benefit analysis to study the effectiveness of IVS for PPS, which is best done with prospective study design, could not be performed.

Conclusion

This study demonstrates that PPS outside the operating room under IVS and GA are both effective. However GA for such procedures may result in increased recovery duration and cost to the patient. Most PPS can be performed under IVS and do not require GA. Nevertheless, it is important to establish a PPS service which includes skilled providers and trained nurses. It is equally important to create a triaging tool to identify those few at-risk patients with airway compromise that need airway protection and GA.

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