Intravenous Sedation vs General Anesthesia for Pediatric Otolaryngology Procedures

Samuel G. Shiley, MD; Kirk Lalwani, MD; Henry A. Milczuk, MD

**Objective:** To compare efficacy, safety, and hospital charges for common pediatric otolaryngology procedures with the use of intravenous sedation (IVS) vs general anesthesia (GA).

**Design:** Retrospective chart study.

**Setting:** Hospital-based pediatric otolaryngology practice.

**Patients:** Patients younger than 18 years who underwent tympanostomy tube removal and/or patch myringoplasty with absorbable gelatin sponge, nasal ciliary biopsy, fine-needle aspiration, or other minor procedures between September 1, 1998, and August 31, 2001.

**Interventions:** Procedures performed in 2 settings: outpatient clinic with IVS or operating room with GA.

**Main Outcome Measures:** Procedure completion rate, tympanic membrane perforation rate after ear procedures, complications, and hospital charges.

**Results:** Of 103 procedures, 54 were performed with IVS and 49 with GA. Within the GA group, 32 of 49 patients had additional operations performed and were excluded from analysis of safety and hospital charges. Procedure completion rate was 100% in both groups. The most common procedure was tympanostomy tube removal with patch myringoplasty (IVS, 52 ears; GA, 42 ears). The rate of persistent tympanic membrane perforation was similar between these groups (IVS, 7 [16%] of 45 ears; GA, 5 [15%] of 33; P = .96). All complications were minor and occurred at similar rates (IVS, 10 [19%] of 54 ears; GA, 3 [18%] of 17; P = .94). These events included hypoxia, airway obstruction, and bradycardia, all of which resolved spontaneously or responded to noninvasive interventions such as oxygen or repositioning. Average hospital charges were significantly higher for the GA group (IVS, $356.22; GA, $1516.55; P < .001).

**Conclusion:** Various procedures can be performed safely, effectively, and with decreased hospital charges with the use of IVS administered by a pediatric sedation service.


During the past 2 decades, a growing body of literature has addressed the use of intravenous sedation (IVS) for pediatric procedures. Pediatric sedation was first used widely to facilitate dental and oral surgery procedures and to immobilize patients undergoing computed tomography or magnetic resonance imaging. Subsequently, IVS has been increasingly used in the fields of pediatric oncology, gastroenterology, emergency medicine, and several other specialties. To our knowledge, there has been no description of the use of IVS in the pediatric otolaryngology setting.

Several procedures encountered in a pediatric otolaryngology practice have traditionally required general anesthesia because of their painful and anxiety-provoking nature in a subset of patients. Examples include removal of tympanostomy tubes, patch myringoplasty, foreign body removal from the ear or nose, fine-needle aspiration, and nasociliary biopsies. Since September 1998, the Department of Otolaryngology–Head and Neck Surgery at Oregon Health & Science University, Portland (OHSU), has used the Pediatric Sedation Service for many of these procedures. This service, staffed full-time by dedicated pediatric anesthesiologists and nurses, was established at OHSU in 1995 to provide sedation for a variety of pediatric procedures. We believe this service provides a safe, effective, and cost-saving alternative to performing such procedures in the operating room. To test this hypothesis, we reviewed our experience with use of the Pediatric Sedation Service to perform minor procedures in the outpatient clinic.

**Data Collection**

All procedures (n = 54) in which IVS was used in the pediatric otolaryngology clinic at OHSU during a 3-year period between September 1, 1998, and August 31, 2001, were reviewed. Pro-
Intravenous Sedation, General Anesthesia, 

<table>
<thead>
<tr>
<th>Procedure</th>
<th>No. (% of Total)</th>
<th>No. (% of Total)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tube removal with GPM</td>
<td>36 (67)</td>
<td>26 (53)</td>
</tr>
<tr>
<td>GPM alone</td>
<td>4 (7)</td>
<td>8 (16)</td>
</tr>
<tr>
<td>Tube removal alone</td>
<td>2 (4)</td>
<td>3 (6)</td>
</tr>
<tr>
<td>Biopsy</td>
<td>6 (11)</td>
<td>6 (12)</td>
</tr>
<tr>
<td>Other</td>
<td>6 (11)</td>
<td>6 (12)</td>
</tr>
</tbody>
</table>

Table 1. Procedures Performed

Abbreviation: GPM, patch myringoplasty using absorbable gelatin sponge.

†Because of rounding, percentages may not total 100.

Of the 103 minor procedures, 54 were performed in the outpatient clinic with IVS and 49 were performed in the operating room with GA. Thirty-two of the 49 patients in the GA group had additional operations performed at the time of the procedure (Table 2). These patients were included in review of procedure efficacy but excluded from analysis of safety and hospital charges. Patient groups were compared accordingly. If the procedure and patient are considered appropriate for IVS by the pediatric otolaryngologist, parents are given a choice of IVS or GA for the procedure. When IVS is selected, the child then undergoes prescreening performed by the Pediatric Sedation Service. During this encounter, the patient is carefully examined for contraindications to IVS, such as known or suspected airway problems, pulmonary disease, certain neurologic conditions, and other medical problems.11 Behavioral issues or developmental status that would complicate the establishment of intravenous access in the clinic are also viewed as contraindications to IVS. If the patient is deemed an inappropriate candidate for IVS, the procedure is scheduled for the operating room with GA.

Patients selected as appropriate candidates for IVS are then prepared according to standard Pediatric Sedation Service protocol, which includes appropriate fasting interval and topical anesthesia for intravenous access. Parents are provided with a prilocaine-based anesthetic cream (EMLA; AstraZeneca Pharmaceuticals, Wilmington, Del) to apply to the child’s hand at least 1 hour before the procedure. On arrival for a scheduled procedure, intravenous access is established at the topically anesthetized site and monitoring equipment is secured. Continuous cardiopulmonary monitoring is performed, and vital signs are recorded beginning immediately before sedative administration until the time at which discharge criteria are met. To initiate sedation, propofol is infused as a bolus dose of 2.0 to 3.0 mg/kg, with subsequent boluses of 0.3 to 1.0 mg/kg to achieve or maintain an adequate level of sedation. For similar procedures performed in the operating room, GA is administered by means of inhalational mask induction and maintenance with sevoflurane in nitrous oxide and oxygen. After both IVS and GA procedures, patients are monitored during recovery until standard discharge criteria12 are met.

### RESULTS

Of the 103 minor procedures, 54 were performed in the outpatient clinic with IVS and 49 were performed in the operating room with GA. Thirty-two of the 49 patients in the GA group had additional operations performed at the time of the procedure (Table 2). These patients were included in review of procedure efficacy but excluded from analysis of safety and hospital charges. Patient groups were similar with respect to average age and duration of follow-up (Table 3).

### EFFICACY

To compare efficacy between groups, procedure completion rate and outcomes were assessed. Procedure completion rate was 100% in both groups. Outcomes of ear procedures were assessed by evaluating TM status at follow-up visits. The most common procedure was tympanostomy tube removal with GPM, performed on 52 ears in the IVS group and 42 ears in the GA group. Follow-up
Within the GA group, 32 of 49 patients had additional operations performed at the time of the minor procedure. These patients were excluded from analysis of safety and hospital charges. The remainder of the GA group (n=17) and the entire IVS group (n=54) were reviewed for occurrence of anesthetic complications. No patient became apneic or required intubation or hospitalization because of complications. Minor complications occurred in 10 patients (19%) in the IVS group and 3 patients (18%) in the GA group (Table 5). This difference in complication rate was not statistically significant (P=.94). Adverse events included transient hypoxia (oxygen saturation, ≤92%), airway obstruction, and bradycardia. All such adverse effects resolved spontaneously or responded to noninvasive interventions such as oxygen by face mask, chin lift, jaw thrust, or oral airway (Table 5).

There was no significant difference between IVS and GA with respect to surgeon and anesthesiologist charges (not listed). As detailed in Table 6, however, hospital charges were significantly less for procedures performed in the outpatient clinic with IVS. For the most common procedure, tympanostomy tube removal with GPM, an additional $1352.84 in hospital charges was generated when the procedure was performed in the operating room. Taking all procedures into consideration, cases

data were available for 45 ears treated in the IVS group and 33 ears treated under GA. The rate of persistent perforation was similar between groups (IVS, 16%; vs GA, 15%; P=.96) (Table 4). The TM perforation rate was also calculated with all ear procedures taken into consideration, and again no significant difference was seen between the IVS and GA groups (Table 4). Biopsy outcomes were assessed by reviewing the final pathology report for each specimen. Although the limited number of cases does not permit meaningful statistical analysis, nondiagnostic biopsies occurred at an identical rate of 33% in both the GA group (2/6) and the IVS group (2/6).

SAFETY AND COST

Within the GA group, 32 of 49 patients had additional operations performed at the time of the minor procedure. In both the GA group (2/6) and the IVS group (2/6), additional diagnostic biopsies occurred at an identical rate of 33% in both the GA group (2/6) and the IVS group (2/6).
performed in the operating room incurred an additional $1160.33 in average charges.

**COMMENT**

As the use of IVS for pediatric procedures has become more common, the availability of anesthesia services to administer IVS has also increased. The level of sedation achieved with IVS is often categorized as conscious or deep sedation. As defined by the American Academy of Pediatrics, Committee on Drugs, conscious sedation implies a minimally depressed level of consciousness in which the patient continues to respond to verbal and/or physical stimuli. Under conscious sedation, the patient retains the ability to maintain a patent airway independently. This contrasts with deep sedation, which involves a controlled level of unconsciousness that may be accompanied by inability to maintain a patent airway.

Before 1995, a nurse-led service was available at OHSU to provide conscious sedation for pediatric patients undergoing computed tomography or magnetic resonance imaging. While conscious sedation is suitable for most radiographic procedures, the stimulating and painful nature of minor surgical procedures often necessitates deep sedation. A growing demand for deep sedation to facilitate such procedures outside of the operating room led to increasing involvement of the OHSU pediatric anesthesiology service to provide airway management. In 1995, a formal Pediatric Sedation Service was established, staffed full-time by pediatric anesthesiologists and specialized sedation nurses. This service now provides sedation for several thousand procedures throughout the hospital each year. Owing to its mobile sedation cart, which contains pharmacologic agents as well as monitoring and airway management equipment, the service is capable of providing sedation at nearly any site in the hospital.

In the current study, we reviewed our experience with the Pediatric Sedation Service when used for minor pediatric otolaryngology procedures. Our objective was to compare the efficacy, safety, and hospital charges for procedures performed with IVS in an outpatient clinic vs GA in the operating room. The use of IVS rather than GA appeared to have no impact on procedure efficacy. Procedure completion rate was 100% in both groups and outcomes were similar between groups. The most common procedure was tympanostomy tube removal with GPM, performed on 52 ears in the IVS group and 42 ears in the GA group. To compare outcome between groups, we calculated the rate of persistent TM perforation as assessed by postoperative follow-up. Reported rates of persistent perforation after elective tube removal range from 4.5% to 28.3%. In our series, there was no significant difference in perforation rate between groups (IVS, 16%, vs GA, 15%; P = .96), and both rates are within the reported range. Procedure efficacy also appeared to be similar between groups for less common procedures such as biopsies, but the small number of cases did not permit meaningful statistical analysis.

In addition to demonstrating similar efficacy, our data indicate that IVS can be administered safely in a hospital-based pediatric otolaryngology clinic by a pediatric sedation team. Minor complications occurred at a similar rate in the GA and IVS settings (IVS, 19%, vs GA, 18%; P = .94), and no major complications occurred in either group. In patients who received propofol, complications included transient hypoxia (11%) and airway obstruction (11%). All events resolved with noninvasive interventions such as supplemental oxygen and/or repositioning. Similar findings were noted by Hertzog et al in a recent evaluation of 50 consecutive pediatric oncologic procedures using propofol IVS. Procedures such as lumbar puncture and bone marrow biopsy were performed in the pediatric intensive care unit setting with sedation and airway management administered by a pediatric intensivist. Similar to our results, they observed several minor airway complications including transient hypoxia (4%) and airway obstruction (12%).

Despite the lack of major complications in these series, the findings highlight the fact that deep sedation should only be administered by a physician skilled in airway management. In addition to hypventilation, apnea, and airway obstruction, potential risks of IVS include seizures, anaphylaxis, and cardiopulmonary arrest. For this reason, immediate access to emergency equipment is also essential, as detailed in the “Guidelines for Monitoring and Management of Pediatric Patients During and After Sedation for Diagnostic and Therapeutic Procedures.” These requirements preclude the use of IVS for pediatric otolaryngology procedures in many non-hospital facilities.

The most striking difference between the IVS and GA groups in this study was found in procedure charges. There were no significant differences between the 2 groups with respect to surgeon or anesthesiologist charges. The surgeon’s fee is based on Current Procedural Terminology code and is not affected by location within the hospital. Anesthesia charges at OHSU are based on procedure time, with a base charge for the first 15 minutes and incremental charges for each additional 15-minute block. In the current study, we observed a trend toward decreased procedure time in the IVS group (data not shown), but this did not produce significant anesthesia savings.

Hospital charges, however, added an average of $1160.33 to procedure charges when performed in the operating room. For the most common procedure, tympanostomy tube removal with GPM, an additional $1352.84 in hospital charges was generated when the procedure was performed in the operating room. Similar findings were noted by Squires et al in a prospective evaluation of pediatric gastroenterology procedures. When procedures such as colonoscopy and esophagogastroduodenoscopy were performed in an endoscopy suite with IVS rather than the operating room with GA, average hospital charges decreased by $1196.90. Similar to our results, their findings showed a significant decrease in hospital charges when operating room and recovery unit charges are avoided.

The present study has several limitations. Because of its retrospective design, there was wide variability in patient follow-up intervals. This may have impacted TM perforation rates, as patients were seen at variable points after the procedure. We attempted to control this factor by including only results seen within 6 months of the pro-
procedure. Several patients had perforations at 1 month and healed TMs at 7 to 8 months. Because of our 6-month cutoff, these patients were considered to have persistent perforations. If we had included follow-up assessments beyond 6 months, the perforation rate may have been lower in both groups.

The inclusion of patients receiving GA who had additional operations in the analysis of TM perforation rates could also have affected results. Adenoidectomy, in particular, could potentially confound rates of TM healing. Our impression, however, was that all of the additional operations (Table 2) would have either a positive effect (adenoidectomy with or without tonsillectomy; n = 7) or no effect (n = 25) on TM healing rate in the GA group. Within the GA group, no significant difference was observed in TM perforation rate in patients who had additional operations vs ear procedures alone (13% vs 17%; P = .79).

There were additional shortcomings in our safety analysis. As described previously, all patients who underwent additional operations at the time of the procedure were excluded from analysis of safety and hospital charges. In the GA group, this significantly reduced our sample size from 49 to 17 patients. Furthermore, comparison of complication rates between the IVS and GA groups is weakened by selection bias. The IVS and GA groups do not represent randomly selected populations, and the GA group may comprise a population with a higher baseline anesthetic risk. Parents are given the option of having the procedure performed with IVS or GA, but the patient must be screened by the anesthesiology service to qualify for IVS. There are several contraindications to sedation, such as airway problems, respiratory disease, and certain neurologic conditions. Behavioral issues that would complicate establishment of intravenous access in the clinic are also viewed as a relative contraindication to IVS. Our intention, however, was not to compare comorbid medical conditions and behavioral issues between the 2 groups. Rather, our objective was to demonstrate that IVS could be used safely in appropriately selected patients.

Finally, there are important drawbacks in our economic analysis. Similar to the safety analysis, exclusion of patients who underwent additional operations reduced the sample size in the GA group from 49 to 17. In addition, OHSU fiscal services provided only the total dollar amount billed to the patient by the hospital on the day of each procedure. Our economic analysis is therefore limited to a comparison of hospital charges, and we cannot draw conclusions about actual patient costs. As detailed in Kezirian and Yueh’s recent review of economic analyses in the otolaryngology literature, it is inaccurate to equate charges with costs. Furthermore, the accounting department was unable to generate itemized billing statements to facilitate a more detailed analysis of charges. As such, we were unable to further determine the source of the significant difference in hospital charges between groups. We attributed the savings of the IVS group to patients’ avoidance of operating room and recovery unit charges, but do not have figures available to detail this difference.

This review demonstrates that pediatric otolaryngology procedures can be performed effectively and safely in a hospital-based outpatient clinic when IVS and monitoring are provided by a pediatric sedation team. Although our economic analysis has limitations, it appears that a significant decrease in hospital charges occurs with this approach.

Accepted for publication October 8, 2002.

This study was presented as a poster at the American Society of Pediatric Otolaryngology Annual Meeting, Scottsdale, Ariz, May 10, 2001, and also as a poster at the American Society of Anesthesiologists Annual Scientific Meeting, New Orleans, La, October 13, 2001.

Corresponding author: Henry A. Milczuk, MD, Mailcode PV01, Oregon Health & Science University, 3181 SW Sam Jackson Park Rd, Portland, OR 97239 (e-mail: milczuh@ohsu.edu).

**REFERENCES**