

## Procedural Sedation Use in the ED: Management of Pediatric Ear and Nose Foreign Bodies

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This is the first report of which we are aware that describes the use of procedural sedation for the emergency department management of ear and nose foreign bodies in children < 18 years of age. During a 5.5-year period, we identified 312 cases of children with a foreign body in a single orifice (174 ear, 138 nose). Procedural sedation was performed in 23% of cases (43 ear, 28 nose) and ketamine was used most commonly (92%). Emergency physicians had a high rate of success in removing foreign bodies (84% ear, 95% nose) and a low complication rate. Procedural sedation had a positive effect on the success rate as more than half of the sedation cases had undergone failed attempts without sedation by the same physician. Emergency physicians should have familiarity with this indication for procedural sedation. (*Am J Emerg Med* 2004;22:310-314. © 2004 Elsevier Inc. All rights reserved.)

Retrieving foreign bodies (FBs) from the ears and noses of children in the emergency department (ED) is a common and generally satisfying part of the daily practice for an emergency physician (EP). Since Baker's original description,<sup>1</sup> studies of the management of pediatric ear and nose FBs in the ED have appeared in the emergency medicine,<sup>2</sup> pediatric,<sup>3,4</sup> and otolaryngology literature.<sup>5-7</sup> Although our clinical experience suggested that the use of procedural sedation was common in the ED, none of these prior studies reported any data on the use of procedural sedation. Even recent review articles specifically addressing ear and nose FBs in the ED make no mention of the use of procedural sedation.<sup>8,9</sup>

The objective of our study was to describe our institutional experience with procedural sedation use in the ED management of pediatric ear and nose FBs. The impact of procedural sedation on the success rate for pediatric ear and nose foreign body removal in the ED will be discussed. Four potential predictors for the use of procedural sedation are examined.

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### METHODS

We performed a retrospective medical record review of all children < 18 years of age who presented to our tertiary care, university based ED with a diagnosis of ear or nose FB (International Classification of Diseases, 9<sup>th</sup> revision [ICD-9] codes 931 and 932). The study period was from January 1, 1997 through July 15, 2002. Subjects were to be excluded if their medical record was unavailable.

We performed a chart review using a standardized form. All data abstractors were trained and monitored periodically. Given the objective nature of the data collected, it was not felt necessary to blind the data abstractors to the study objective. Data recorded included: date of birth, date of ED visit, gender, FB identity, presenting symptoms, the procedure physician (EP and/or ear, nose, and throat [ENT] consultant), sedation medications and medication route, technique(s) used, documented complications (codified as none, bleeding, posterior nasal dislodgment, perforation of the tympanic membrane, or other), and outcome of the ED visit. From the date of ED visit and date of birth, the age was electronically calculated. Subjects were grouped according to the following: FB in a single orifice (ear or nose), FBs in multiple orificia, FBs that were spontaneously expelled, subjects who checked in at the ED triage area but left before a physical examination, subjects without a FB identified on physical examination, subjects with FBs imbedded in the ear lobe (same ICD-9 code as ear canal), and very unusual cases.

To assess the reliability of our data abstraction, a convenience sample of 11% of the total number of study subjects was identified and independently reviewed by a second data abstractor blinded to the first review. Interobserver reliability was assessed using the concordance rate and unweighted kappa statistic.

The identity of each FB was recorded as it was stated in the medical record. For descriptive analysis, the FBs were assigned 1 of 8 categories using a classification system that has been previously described.<sup>5</sup>

Due to nonnormal distributions we report our descriptive data using medians and interquartile ranges (IQR).<sup>10</sup> We performed a multiple logistic regression analysis to assess the predictive value of age, gender, orifice (ear or nose), and whether the FB was hard, regular and spherical to identify cases undergoing procedural sedation. Variables retaining

**TABLE 1.** Presenting Symptoms of Children With Foreign Bodies in a Single Orifice

	Ear (n = 174)*	Nose (n = 138)†
	n (%)	N (%)
Asymptomatic	81 (47%)	60 (43%)
Pain	47 (27%)	5 (4%)
Bleeding	11 (6%)	16 (12%)
Foreign body sensation	14 (8%)	3 (2%)
Sneezing	1 (1%)	8 (6%)
Coughing	3 (2%)	3 (2%)
Nonbloody discharge	4 (2%)	9 (7%)
Foul odor	0 (0%)	14 (10%)
Agitation	1 (1%)	1 (1%)
Decreased hearing	5 (3%)	N/A
Unilateral nasal discharge	N/A	16 (12%)
Not documented	13 (7%)	12 (9%)

Abbreviation: N/A, not applicable.

NOTE. Percentage totals are greater than 100% due to subjects having multiple symptoms.

\*9 children had 2 symptoms and 1 child had 3 symptoms recorded. †11 children had 2 symptoms and 2 children had 3 symptoms recorded.

an association with the use of procedural sedation and  $P < .05$  were considered to have an independent association. We calculated the area under the receiver operating characteristic (ROC) curve and performed goodness-of-fit analysis using the Hosmer-Lemeshow test. We used bootstrap validation to obtain 95% bias-corrected confidence intervals (CIs) of the predictor variables. Statistical analyses were performed using STATA 7 (Stata Press, College Station, TX). Our Institutional Review Board approved this study.

**RESULTS**

We identified 367 subjects who met our inclusion criteria. This group was 43% female. The median age was 4.3 years (range 42 days-17.6 years, IQR 2.9-6.8 years). The major groupings were as follows: 312 subjects with FBs in a single orifice (174 ear, 138 nose), 10 subjects with FBs in multiple orificia, 19 cases in which the FB was spontaneously expelled, 12 cases in which the subject checked in at the triage area but left before a physical examination, 5 subjects for whom no FB could be identified, 7 cases in which the FB was embedded in the ear lobe, and 2 cases which we

**TABLE 2.** Sedation Use by Object Classification

	Ear (n = 174)	Nose (n = 138)
Soft and irregular	3/31 (10%)	4/19 (21%)
Pliable or rubber-like	9/26 (35%)	6/35 (17%)
Hard and irregular	10/42 (24%)	7/27 (26%)
Hard, regular, and spherical	11/31 (35%)	3/34 (9%)
Popcorn kernels	3/19 (16%)	2/3 (67%)
Other hard, regular, nonspherical	0/2 (0%)	4/14 (29%)
Insects or spiders	5/18 (28%)	No cases
Unknown	2/5 (40%)	2/6 (33%)

Classification categories data adapted from reference 5.

NOTE. Percentages may not add up to 100% due to rounding

**TABLE 3.** Frequency of Sedation Use and Complications

	Ear (n = 174)	Nose (n = 138)
No complications	33/147 (23%)	21/108 (19%)
Bleeding	8/24 (33%)	5/27 (19%)
Perforated tympanic membrane	1/2 (50%)	N/A
Posterior nasal dislodgment*	N/A	2/3 (67%)
Other†	1/1 (100%)	No cases

Abbreviation: N/A, not applicable.

NOTE. Percentages may not add up to 100% due to rounding.

\*All cases were described as swallowed. No aspirations noted.

†Described as “trauma to the [tympanic membrane] without perforation.”

classified as very unusual. The 312 subjects with FBs in a single orifice constituted our main study group. All of the medical records were available for review.

Of the 174 subjects with unilateral ear canal FBs, 63% (109 of 174) were boys. The median age of this group was 6.1 years (range 1.4-17.6 years, IQR 4.3-9.3 years). These children were most commonly asymptomatic (Table 1) and had objects that were hard and irregular (Table 2). Complications were uncommon (Table 3). The technique that was most commonly successful was the use of forceps (Table 4). EPs successfully removed 77% (134 of 174) of the FBs without consultation. The EP did not make an attempt to remove the FB in 15 cases. Of those cases in which the EP attempted to remove the foreign body, the success rate was 84% (134 of 159).

Of the 138 subjects with unilateral nasal foreign bodies, 50% (70 of 138) were boys. The median age of this group was 3.0 years (range 1.4-14.8 years, IQR 2.3-4.1 years). These children were most commonly asymptomatic (Table 1). The most common FBs were either pliable and rubber-like (35 of 138, 25%) or hard, regular, and spherical (34 of

**TABLE 4.** Frequency of Sedation Use and Successful Techniques\*

	Ear (n = 174)	Nose (n = 138)
Forceps	9/52 (17%)	13/59 (22%)
Hook	4/29 (14%)	1/31 (3%)
Irrigation	3/26 (12%)	0/1 (0%)
Loop or curette	4/21 (19%)	0/11 (0%)
Suction	0/7 (0%)	2/11 (18%)
Balloon catheter	No cases	0/4 (0%)
Superglue	No cases	No cases
Positive pressure (“kiss” or bag)	N/A	0/4 (0%)
Other†	2/2 (100%)	2/2 (100%)
No successful technique in ED	0/3 (0%)	No cases
No attempt made in ED	0/2 (0%)	No cases
Not documented	21/32 (66%)	10/15 (67%)

Abbreviation: N/A, not applicable.

NOTE. Percentages may not add up to 100% due to rounding.

\*The technique that was documented as the successful technique regardless of number of prior attempts using alternative techniques.

†Includes: 2 cases listed as “myringotomy tray instruments” (ear); 1 case of fiberoptic nasoscope use by ENT (nose); one case “with the help of a nasal trumpet” (nose).

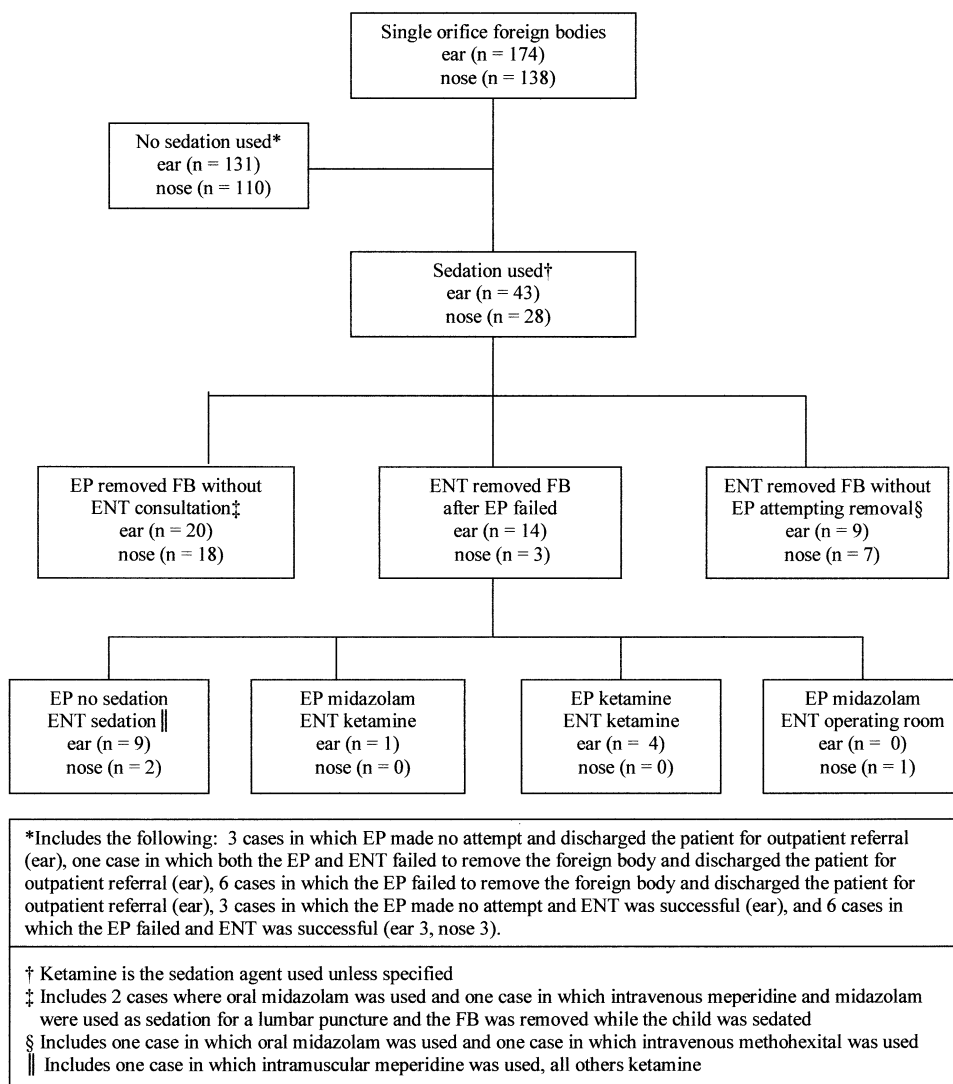


FIGURE 1. ED procedural sedation use for ear and nose foreign body (FB) removal by emergency physicians (EP) and ear, nose, and throat (ENT) consultants (n = 312).

138, 25%) (Table 2). Complications were uncommon (Table 3). The technique that was most commonly successful was the use of forceps (Table 4). EPs successfully removed 91% (125 of 138) of the FBs without consultation (Fig 1). The EP did not attempt to remove the FB in 7 cases. Of those cases in which the EP attempted to remove the FB, the success rate was 95% (125 of 131).

None of the subjects went directly to the operating room from the ED for FB removal. Two subjects were admitted to the hospital. One was a 5-year-old girl admitted for meningitis who had a bead removed from her ear by the EP in the ED. The other was a developmentally delayed 4-year-old girl admitted for pneumonia. The EP in this case was unable to remove a metal screw from her nose using midazolam sedation and the ENT elected to remove the FB in the operating room after 4 days of inpatient antibiotics.

There were 10 (3%) cases for which we do not have data on the successful removal of the FB: 6 cases in which the EP failed to remove an ear FB and discharged the patient home for outpatient referral, 1 case in which both the EP and ENT failed to remove an ear FB and discharged the patient home for outpatient referral, and 3 cases in which the

EP made no attempt to remove an ear foreign body and discharged the patient home for outpatient referral. None of these cases involved the use of procedural sedation in the ED.

Procedural sedation was used in 71 of 312 (23%) cases (Fig 1). Ketamine was used in 92% (65 of 71) of sedation cases. Thirty-five EPs managed these 312 cases. Eight physicians managed the majority of these cases. There was substantial practice variation in the frequency with which these physicians used procedural sedation (Table 5). We examined 4 predictor variables for the use of procedural sedation: age, gender, orifice (ear or nose), and whether the FB was hard, regular and spherical. None of these variables had an independent association with the use of procedural sedation (Table 6). Of the 43 ear FB cases that involved procedural sedation, 25 (58%) had undergone failed attempts without sedation in the ED. Of the 28 nose FB cases that involved procedural sedation, 12 (43%) had undergone failed attempts without sedation in the ED.

For the subjects who did not have a FB in a single orifice, we present the following results. There were 10 cases of FBs in multiple orificia. One case involved a 10-year-old

**TABLE 5.** Procedural Sedation Use by Individual Emergency Physicians

Physician Number	Ear foreign bodies (n = 174)	Nose foreign bodies (n = 138)	Total foreign bodies (n = 312)
1	6/32 (19%)	5/29 (17%)	11/61 (18%)
2	2/21 (10%)	1/17 (6%)	3/38 (8%)
3	1/14 (7%)	1/20 (5%)	2/34 (6%)
4	6/18 (33%)	9/14 (64%)	15/32 (47%)
5	10/16 (63%)	5/14 (36%)	15/30 (50%)
6	4/14 (29%)	0/11 (0%)	4/25 (16%)
7	5/8 (63%)	4/6 (67%)	9/14 (64%)
8	0/6 (0%)	1/4 (25%)	1/10 (10%)
Other physicians*	9/45 (20%)	2/23 (9%)	11/68 (16%)
Total	43/174 (25%)	28/138 (20%)	71/312 (23%)

NOTE. Percentages may not add up to 100% due to rounding.

\*35 physicians managed these 312 cases of ear and nose foreign bodies in a single orifice. This row represents the 27 physicians who managed fewer than 10 foreign body cases during the study period.

girl with magnets adherent to each other across the nasal septum. Using intravenous ketamine sedation, the ENT consultant removed the magnets using a nasoscope. The other 9 cases with foreign bodies in multiple orificia involved the ears and all of these foreign bodies were removed in the ED. The median age of these children was 5.6 years and ketamine sedation was used in 3 cases. The EP was successful for 17 of 18 of these foreign bodies in the ears with ENT consulted for 1 FB. Of the 19 cases in which the FB was spontaneously expelled, 17 were nose FBs. The other 2 included an insect in the ear that spontaneously crawled out of the ear canal and a small wad of paper that fell out of the ear. The 2 cases classified as very unusual involved 13-year-olds. One of these adolescents had ear canal glass identified during trauma resuscitation after a motor vehicle accident and the other was the resident of a chronic care facility who needed a nasal trumpet removed.

To assess our interobserver reliability, 39 (11%) charts were reviewed by a second chart abstractor blinded to the results of the first review. The following variables had perfect agreement (concordance rate 100%, kappa 1.0): gender, orifice (ear or nose), procedure physician (EP and/or ENT), use of sedation, and procedural outcome. FB classification and procedural technique had concordance rates of 95% and 90% respectively with kappa statistics of 0.94 and 0.84, representing excellent interobserver agreement.<sup>11</sup> Complications and symptom identification had concordance rates of 87% and 79% respectively with kappa statistics of 0.60 and 0.62, representing good interobserver agreement.<sup>11</sup>

**TABLE 6.** Predictors of the Use of Procedural Sedation in Children With an Aural or Nasal Foreign Body (n = 312)

Variable	Odds Ratio	Bias-Corrected 95% CI	P Value
Age (months)	1.03	0.94, 1.12	.540
Orifice (ear or nose)	0.84	0.43, 1.60	.595
Gender	1.19	0.71, 1.92	.525
Object hard, regular and spherical	0.84	0.45, 1.67	.595

NOTE. The area under the model receiver operator curve was .531. The model demonstrated satisfactory goodness-of-fit, with Hosmer-Lemeshow *P* = .489.

**DISCUSSION**

Ours is the first study of which we are aware that describes experience with procedural sedation in the ED management of pediatric ear and nose FBs. We found that procedural sedation was commonly used in the ED management of pediatric ear and nose FBs. In our study, 25% of children with ear FBs and 21% of children with nose FBs underwent procedural sedation in the ED.

The use of procedural sedation, and in particular ketamine sedation, appeared to have a positive effect on the success rate of FB body removal in the ED. More than half of all procedural sedation cases had had failed attempts in the ED without sedation. There were only 4 cases in which the EP was unable to remove ear FBs using ketamine procedural sedation. Our reported success rates for EPs (84% ear, 95% nose) removing FBs compare favorably with other studies. Other studies reported EP success rates for removal of ear FBs of 88%,<sup>1</sup> 77%,<sup>5</sup> and 53%<sup>6</sup> and for removal of nose FBs of 92%<sup>1</sup> and 98%.<sup>2</sup> These other studies do not report data on the use of procedural sedation.

In our study, one child went to the operating room to have a nasal FB removed during an inpatient hospitalization for an unrelated condition. This represents 0.7% of nasal FBs in our main study group. None of the ear FBs from our main study group were removed in the operating room. However, we lack follow-up data on 10 ear FBs. If we conservatively assume that all 10 of these children eventually went to the operating room for FB removal, this would represent 5.7% operating room utilization. Therefore, we estimate the operating room utilization rate to be from 0%-5.7% for ear FBs and less than 1% for nose FBs. Our operating room utilization rate compares favorably with that of previous studies. Ansley and colleagues reported operating room utilization in 57 of 191 (30%) of children < 18 years of age with ear FBs.<sup>3</sup> Schulze and colleagues reported operating room utilization in 72 of 698 (10%) of children < 22 years of age with ear FBs.<sup>5</sup> Baker reported that 1 of 134 (< 1%) of ear FBs and 0 of 78 (0%) nose FBs required removal in the operating room.<sup>1</sup> Kadish and Corneli reported that 0 of 60 (0%) nose FBs required removal in the operating room.<sup>2</sup>

Using procedural sedation in the ED to remove ear and nose FBs is probably less costly than removal in the operating room. It seems reasonable to suggest that adding the

cost of procedural sedation to an ED visit would be less than adding the cost of operating room and postoperative recovery costs to an ED visit. Because we had only a single case that underwent removal in the operating room, we had an insufficient number of operating room cases to compare costs.

We examined patient and object characteristics that had been previously suggested to be associated with more challenging cases or higher complication rates.<sup>3,5,6</sup> It would be interesting to identify patient or object characteristics that would predict procedural sedation use. If there were a subset of patients in whom procedural sedation is commonly needed, EPs may elect to avoid FB removal attempts in these children before the administration of procedural sedation. However, none of the variables that we investigated were independently associated with procedural sedation use. Prospective studies that examine other characteristics may be able to identify this subset of patients.

Our study had limitations. The retrospective nature of the study limited the number of variables that we were able to explore. For example, Schulze and colleagues examined the location of ear FBs within the ear canal.<sup>5</sup> These data were not available for our study subjects. We had few cases that used sedation other than ketamine and therefore had an insufficient number of cases to comment on the effectiveness of other sedation agents. Although there was significant practice variability in the use of procedural sedation among the EPs, the retrospective nature of the study does not allow us to assess the reasons why physicians did or did not choose to use procedural sedation for a given case. We had 10 cases for which we do not know the ultimate outcome of the retained FB.

Although the majority of pediatric ear and nose FBs can be managed in the ED without procedural sedation, a sub-

stantial number of children appear to benefit from the use of procedural sedation. We demonstrated a high success rate for EPs managing pediatric ear and nose FBs. The success rate was enhanced by the use of procedural sedation. It appears the decision to use procedural sedation is not based on simple patient or object characteristics. Familiarity with the use of procedural sedation for the management of pediatric ear and nose FBs should be a part of the practice in all EDs where children receive care.

## REFERENCES

1. Baker MD: Foreign bodies of the ears and nose in childhood. *Pediatr Emerg Care* 1987;3:67-70
2. Kadish HA, Corneli HM: Removal of nasal foreign bodies in the pediatric population. *Am J Emerg Med* 1997;15:54-56
3. Ansley JF, Cunningham MJ: Treatment of aural foreign bodies in children. *Pediatrics* 1998;101:638-641
4. Mishra A, Shukla GK, Bhatia N: Aural foreign bodies. *Indian J Pediatr* 2000;67:267-269
5. Schulze SL, Kerschner J, Beste D: Pediatric external auditory canal foreign bodies: A review of 698 cases. *Otolaryngol Head Neck Surg* 2002;127:73-78
6. DiMuzio J Jr, Deschler DG: Emergency department management of foreign bodies of the external auditory canal in children. *Otol Neurotol* 2002;23:473-5
7. Balbani APS, Sanchez TG, Butugan O, et al: Ear and nose foreign body removal in children. *Int J Pediatr Otorhinolaryngol* 1998;46:37-42
8. Davies PH, Bengner JR: Foreign bodies in the nose and ear: a review of techniques for removal in the emergency department. *J Accid Emerg Med* 2000;17:91-94
9. Kalan A, Tariq M: Foreign bodies in the nasal cavities: a comprehensive review of the aetiology, diagnostic pointers, and therapeutic measures. *Postgrad Med J* 2000;76:484-487
10. Pett MA: *Nonparametric Statistics for Health Care Research: Statistics for Small Samples and Unusual Distributions*. Thousand Oaks, CA, Sage, 1997
11. Fleiss JL: Measuring nominal scale agreement among many raters. *Psychological Bulletin* 1971;76:378-82