Upper Respiratory Infections and Respiratory Adverse Events and Interventions in Emergency Department Sedation of Children

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Study objective: Children with upper respiratory infections (URIs) have an increased risk of respiratory adverse events when undergoing operative anesthesia and in general populations of children receiving procedural sedation. It is unclear if children with URI undergoing emergency department (ED) sedation share the same increased risk. We aimed to determine if the presence of a URI in children undergoing ED sedation is associated with increased risk of respiratory adverse events and serious respiratory interventions.

Methods: We conducted a secondary analysis of a prospective cohort study of children aged 17 years or younger who received parenteral sedation for a painful procedure in 1 of 6 pediatric EDs. A multivariable regression model was used to identify potential associations between URI and respiratory adverse events, serious respiratory adverse events (ie, complete airway obstruction, apnea, laryngospasm, clinically apparent pulmonary aspiration, and death), and serious respiratory interventions (ie, bag-valve-mask ventilation and endotracheal intubation).

Results: We analyzed 6,292 children; 444 (7.1%) had a URI. The risk of respiratory adverse events, serious respiratory adverse events, or serious respiratory interventions was adjusted odds ratio (aOR) 1.00 (95% confidence interval [CI] 0.78 to 1.29), 0.53 (95% CI 0.18 to 1.58), and 1.08 (95% CI 0.68 to 1.71), respectively.

Conclusion: In this study, we found no increase in risk of any respiratory adverse events or serious respiratory interventions associated with URI in children undergoing ED sedation. [Ann Emerg Med. 2025;86:187-191.]

Please see page 188 for the Editor's Capsule Summary of this article.

Keywords: Sedation, Pediatric, Upper respiratory infection, Adverse events, Ketamine.

0196-0644/$-see front matter

https://doi.org/10.1016/j.annemergmed.2025.03.016

INTRODUCTION

Background

The presence of a current or recent upper respiratory tract infection (URI) has been associated with increased risk of respiratory adverse events and interventions in children undergoing operative anesthesia and in general populations of children receiving procedural sedation.[1,2] These events encompass a spectrum of severity ranging from cough to oxygen desaturation to laryngospasm, and interventions can include bag-valve-mask ventilation or endotracheal intubation. As a result, the presence of a current or recent URI may prompt additional risk-mitigating strategies, referral to higher level of care, accessing additional resources, or postponement of procedures.

Importance

It is unclear whether children with URIs undergoing emergency department (ED) sedation share the same increased risk of respiratory adverse events and interventions as those children who undergo anesthesia or sedation in other settings. This is a question of consequence given that URIs are among the most common illnesses in children and most conditions requiring sedation in the ED for definitive treatment are unscheduled, cannot be postponed, or would incur substantial delays if deferred to other services (eg, anesthesia) to perform the sedation.[3,4] In addition, the majority of pediatric ED sedations are performed using ketamine, which is associated with increased salivary and tracheobronchial secretions that could potentially increase the risk of respiratory events when compounded with a recent or current URI.[1,4,5]

Goals of This Investigation

The primary aim of this study was to determine if the presence of a URI was associated with an increased risk of respiratory adverse events and serious respiratory interventions in children undergoing ED sedation.

Editor's Capsule Summary

What is already known on this topic

Upper respiratory infections (URIs) may alter the frequency of adverse events during procedural sedation.

What question this study addressed

In emergency department (ED) children receiving procedural sedation, does a URI change the frequency of a respiratory adverse event?

What this study adds to our knowledge

In this multicenter, observational study of 6,292 ED children of whom 444 (7.1%) had a URI, the frequency of respiratory adverse events and interventions on their behalf was similar with or without a URI.

How this is relevant to clinical practice

ED procedural sedation plans in children do not require specific alteration because of URI presence.

MATERIALS AND METHODS

Study Design and Setting

We conducted a secondary analysis of a prospective, multicenter, observational cohort study conducted in 6 pediatric EDs with a cumulative annual census of approximately 350,000 patients. Patients were enrolled from July 2010 to February 2015. Verbal or written informed consent was obtained depending on the regulations specific to each site, as was approval from the research ethics board at each participating institution. Study methods for the parent study have been previously described in detail.[4,6]

Selection of Participants

Children aged 0 to 17 years (ie, before their 18th birthday) undergoing parenteral procedural sedation performed by emergency physicians for painful procedures were eligible for the study. Exclusion criteria included receipt of a drug purely for anxiolysis or analgesia without the intent of sedation, presence of a language barrier prohibiting obtaining informed consent or missing URI status, adverse event, or intervention data.

Measurements and Outcomes

Presence of a URI was identified by patient and/or family self-report and/or by clinician questioning and defined as the presence of cough and/or rhinorrhea. Presence of URI was collected as a defined data element using a standardized electronic data collection tool.[6] The quality of secretions (eg, thickness) or duration of symptoms was not collected.

Standardized definitions from the Quebec Guidelines were used to categorize respiratory adverse events as serious respiratory adverse events (ie, apnea, complete airway obstruction, laryngospasm, clinically apparent pulmonary aspiration, and death), partial airway obstruction, and oxygen desaturation (defined as the occurrence of desaturation and the performance of one or more appropriate interventions to improve oxygen saturation, eg, tactile stimulation, airway repositioning, oxygen administration or increasing levels of existing supplemental oxygen, and positive pressure ventilation).[7] Serious respiratory interventions were defined as bag-valve-mask ventilation and/or endotracheal intubation performed in response to an adverse event.

Data Analyses

Descriptive statistics were used to summarize patient and procedural characteristics and the incidence of outcomes in patients with and without URIs. The association of URI with outcomes was determined using a multivariable logistic regression model. Predictors included in the model were selected a priori based on previously demonstrated and clinically plausible associations with adverse events and significant interventions during ED sedation. These predictors included patient age, preprocedural opioid use, and sedation medication.[4,8,9] Patient age was modeled using a restricted cubic spline with 3 knots. Preprocedural opioid use was modeled as a dichotomous variable. Sedation medication was modeled using indicators for ketamine alone, ketamine with midazolam, ketamine with propofol, propofol with fentanyl, ketamine with fentanyl, propofol alone, and other. We used cluster-robust standard errors, clustering on hospital. We performed an exploratory analysis evaluating the association of URI with outcomes in children who received a ketamine-based regimen (ie, ketamine was given alone or in combination with another sedative) using a multivariable logistic regression model and the same predictors as the primary analysis. To assess goodness of fit, we performed the le Cessie-van Houwelingen-Copas-Hosmer unweighted sum of squares test and determined the area under the receiver operating characteristic curve (with 95% confidence interval [CI]).[10] Statistical analyses were conducted using R Statistical Software (4.2.1).[11]

RESULTS

Characteristics of Study Participants

There were 6,292 patients from the parent study available for analysis (Table 1). Two patients from the parent study were excluded due to missing URI status; both patients did

Table 1. Patient and procedure characteristics by URI status.

Characteristic	URI n=444	No URI n=5,848
Female, n (%)	149 (33.6)	1,955 (33.4)
Age (y), median (IQR)	5 (2-9)	8 (4-12)
Age range (y), n (%)		
<2	86 (19.4)	435 (7.4)
2-7	211 (47.5)	2,403 (41.1)
8-12	81 (18.2)	1,700 (29.1)
13-17	66 (14.9)	1,310 (22.4)
ASA class I or II, n (%)	443 (99.8)	5,832 (99.7)
Underlying health risk*	34 (7.7)	167 (2.9)
Fasting duration (h), n (%)†		
NPO solids ≤ 6 h	197 (45.5)	2,810 (48.9)
NPO solids ≤ 4 h	65 (15.0)	953 (16.6)
NPO liquids ≤ 2 h	14 (3.2)	305 (5.3)
Preprocedural opioid use, n (%)	114 (25.7)	1,697 (29.0)
Preprocedural antiemetic use, n (%)	103 (23.2)	1,848 (31.6)
Procedure type, n (%)		
Orthopedic reduction	229 (51.6)	3,917 (67.0)
Laceration repair	99 (22.3)	929 (15.9)
Abscess incision and drainage	34 (7.7)	288 (4.9)
Foreign body removal	20 (4.5)	202 (3.5)
Lumbar puncture	32 (7.2)	118 (2.0)
Other‡	30 (6.8)	394 (6.7)
Sedation medication, n (%)		
Ketamine alone	273 (61.5)	3,642 (62.3)
Ketamine + propofol	76 (17.1)	775 (13.3)
Ketamine + midazolam	21 (4.7)	224 (3.8)
Ketamine + fentanyl	11 (2.5)	207 (3.5)
Propofol alone	19 (4.3)	225 (3.8)
Propofol + fentanyl	41 (9.2)	685 (11.7)
Other§	3 (0.7)	90 (1.5)

ASA, American Society of Anesthesiologists; *NPO*, nil per os.
*Stridor when awake, large tongue, micrognathia, preexisting neurologic impairment, history of sleep apnea and snoring, gastroesophageal reflux, chronic constipation, or vomiting.
†Missing values = 112: 11 from URI cohort, 101 from no URI cohort.
‡Dental, paraphimosis reduction joint aspiration, cast application, wound debridement, dressing change, inguinal hernia reduction, chest tube insertion, traction, urinary catheterization, and rectal prolapse reduction.
§Pentobarbital sodium, nitrous oxide, and etomidate.

not have any respiratory adverse events and did not require any respiratory interventions. One patient was excluded due to missing respiratory intervention data; this patient had oxygen desaturation but no serious respiratory adverse events. A URI was identified in 444 (7.1%) patients. The median age of patients analyzed was 8 years (interquartile range [IQR] 4, 12 years), with 521 (8.3%) aged less than 2 years; 2104 (33.4%) of patients were female, 6,275 (99.7%) were American Society of Anesthesiologists (ASA) class I or II, and 4,146 (65.9%) underwent orthopedic reduction. Preprocedural opioids were administered to 1,811 (28.8%) patients; the majority of patients (62.2%) received ketamine alone, with 1,063 (16.9%) patients receiving a sedative regimen that did not include ketamine. No patients received an anticholinergic or antisialogue agent. Children with a URI were younger, and a greater proportion of them had an underlying health risk than children without a URI.

Main Results

The incidence of respiratory adverse events and interventions are shown in Table 2. Overall, the incidence of any respiratory adverse event was 6.6%. A serious respiratory event occurred and a serious respiratory intervention was performed in 0.9% and 1.4% of patients, respectively. There were no increased odds of any respiratory adverse event, serious respiratory adverse event, or serious respiratory intervention in children with a URI after adjusting for patient age, preprocedural opioid use, and sedation medication (Table 3). In children who received a ketamine-based regimen for sedation, there were also no increased odds of these events (Table E1, available at http://www.annemergmed.com). There was no significant lack of fit in any of the models.

LIMITATIONS

We did not assess the quality of URI or history of recent URI (without current symptoms). These factors have been shown to be associated with an increased frequency of airway adverse events, although rates of these adverse events remain low regardless of URI status.[1] Patients identified as having a URI in this study would have had current symptoms with either clear or thick secretions. These patients have increased frequency of airway adverse events compared with those with only a history of recent URI (without current symptoms) who were not included in our population of children with URI.[1] We did not have information about patients who may have been referred to anesthesia or had their sedation deferred based on the presence of a URI. This could have introduced selection bias for a cohort with less severe URI. However, the overall rates of respiratory adverse events in our cohort are no less than that described in children with severe URI symptoms who underwent sedation.[1] The number of serious respiratory adverse events and serious respiratory interventions were low, which affected the precision of our estimates of risk based on the presence of a URI. The low frequency of these events and interventions in children with URIs, however, is clinically meaningful. We did not collect information about other potential risk factors, such as a patient's body mass index, procedure duration, or positioning for the procedure (eg, supine, prone, or side-lying). However, we did

Table 2. Incidence of respiratory adverse events and serious respiratory interventions by URI status in children undergoing sedation in the ED.

Event or Intervention	URI n=444	No URI n=5,848
Respiratory adverse event, n (%)	29 (6.5)	385 (6.6)
Oxygen desaturation, n (%)	24 (5.4)	328 (5.6)
Partial airway obstruction, n (%)	4 (0.9)	41 (0.7)
Serious respiratory adverse event, n (%)	2 (0.5)	55 (0.9)
Apnea	2 (0.5)	52 (0.9)
Laryngospasm	0	4 (0.1)
Complete airway obstruction	0	0
Clinically apparent pulmonary aspiration	0	0
Death	0	0
Respiratory intervention, n (%)	47 (10.6)	563 (9.6)
Supplemental oxygen	18 (4.1)	246 (4.2)
Airway repositioning	23 (5.2)	237 (4.1)
Serious respiratory intervention, n (%)	6 (1.4)	80 (1.4)
Bag-valve-mask ventilation	6 (1.4)	80 (1.4)
Endotracheal intubation	0	0

Each participant may experience one or more adverse events and may receive one or more respiratory interventions.

include in our analysis other pertinent variables known to be associated with increased adverse events and interventions during sedation in children.[4,8,9] These data were collected from pediatric EDs, which may limit the generalizability of our results to other settings.

DISCUSSION

Our study did not identify an increased risk of respiratory adverse events or serious respiratory interventions in children undergoing ED sedation based on the presence of a URI. These outcomes were similar in children who received a ketamine-based regimen for sedation. The overall rates of serious respiratory adverse events and serious respiratory interventions were low.

The presence of a URI is an important clinical consideration for ED clinicians, given the association with increased risk of respiratory adverse events and interventions described in prior literature, the prevalence of URIs in children, and the unscheduled nature of ED sedations.[1,2,4] Our findings do not suggest that the presence of a URI alone should necessitate deferral of sedation or referral to anesthesia, although standard airway and respiratory precautions should continue to be maintained as respiratory adverse events may still occur and serious respiratory interventions may be required, irrespective of URI status.

We conducted an exploratory analysis in children who received a ketamine-based regimen to evaluate the relationship between URI status and respiratory adverse events and interventions in children who may be at risk of experiencing any of the infrequent but considered effects associated with ketamine (eg, hypersalivation and laryngospasm).[5] Similar to the overall cohort, there were no increased odds of these occurrences in children who received a ketamine-based regimen for sedation. Notably, no patients in this cohort received anticholinergics or antisialogogues, so it was not possible to assess the effect of these medications on the risk of respiratory adverse events or interventions in children with URI. However, anticholinergics have not shown efficacy in decreasing airway and respiratory adverse events in children who receive ketamine sedation, and the frequency of such events was already low in our cohort that was devoid of anticholinergic or antisialogogue use.[12]

Table 3. Risk of respiratory adverse events and serious respiratory interventions in children undergoing ED sedation based on URI status.

Event or Intervention	URI n=444	No URI n=5,848	Absolute Difference (95% CI)	aOR (95% CI)
Respiratory adverse event, n (%)	29 (6.5)	385 (6.6)	0.1 (−2.7 to 2.1)	1.00 (0.78-1.29)
Oxygen desaturation	24 (5.4)	328 (5.6)	0.2 (−2.4 to 2.1)	0.97 (0.81-1.16)
Partial airway obstruction	4 (0.9)	41 (0.7)	0.2 (−0.4 to 1.6)	1.22 (0.93-1.60)
Serious respiratory adverse event	2 (0.5)	55 (0.9)	0.4 (−0.7 to 0.9)	0.53 (0.18-1.58)
Apnea	2 (0.5)	52 (0.9)	0.4 (−0.7 to 0.9)	0.51 (0.15-1.76)
Laryngospasm	0	4 (0.1)	0.1 (−0.8 to 0.2)	Not estimable
Serious respiratory intervention, n (%)*	6 (1.4)	80 (1.4)	0 (−1.6 to 0.8)	1.08 (0.68-1.71)

Serious respiratory adverse event: apnea, complete airway obstruction, laryngospasm, clinically apparent pulmonary aspiration, or death. Serious respiratory intervention: bag-valve-mask ventilation and/or endotracheal intubation performed in response to an adverse event.
*All serious respiratory interventions were bag-valve-mask ventilation. No patients underwent endotracheal intubation. Each participant may experience one or more adverse events and may receive one or more respiratory interventions. Covariates used in the multivariable model included patient age, preprocedural opioid use, and sedation medication.

The mitigation of risk when performing procedural sedation in the ED includes an assessment of patient characteristics, including the presence of a URI. Our findings suggest the presence of a URI in and of itself should not be a contraindication to ED procedural sedation warranting deferral of the procedure or referral to anesthesia. Further study should investigate the potential interactions between varying degrees of URI severity and patient or procedural characteristics not available in this cohort and whether the risk of respiratory adverse events or respiratory interventions change based on these interactions.

The authors thank the Sedation Safety Group of Pediatric Emergency Research Canada (PERC).

Supervising editor: Steven M. Green, MD. Specific detailed information about possible conflicts of interest for individual editors is available at https://www.annemergmed.com/editors.

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Author contributions: DST and MB conceptualized the study. DST, NB, and MB designed the study. MB supervised the conduct of the parent study and data collection. NB conducted the statistical analyses. DST, NB, and MB analyzed and interpreted the data. DST drafted the manuscript, and all authors critically revised the manuscript for important intellectual content. DST takes responsibility for the manuscript as a whole.

Data sharing statement: The entire deidentified data set, data dictionary, and analytic code for this investigation are available on request from the date of article publication by contacting Maala Bhatt, MD (mbhatt@cheo.on.ca).

All authors attest to meeting the four ICMJE.org authorship criteria: (1) Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work; AND (2) Drafting the work or revising it critically for important intellectual content; AND (3) Final approval of the version to be published; AND (4) Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Funding and support: By *Annals'* policy, all authors are required to disclose any and all commercial, financial, and other relationships in any way related to the subject of this article as per ICMJE conflict of interest guidelines (see www.icmje.org). The authors have stated that no such relationships exist. The parent study was supported by a Canadian Institutes of Health Research Team Grant in Pediatric Emergency Medicine (FRN-79859).

Publication dates: Received for publication February 7, 2025. Revision received March 12, 2025. Accepted for publication March 17, 2025.

Presentation information: Presented at Pediatric Academic Societies, Toronto, Ontario, Canada, May 3, 2024.

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