

## Original Article

# A Safety Evaluation of Midazolam use for Nasogastric Tube Placement

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## INTRODUCTION

The use of a nasogastric tube (NGT) is frequently indicated in the emergency department (ED) for gastric decompression in the setting of intestinal obstruction, gastrointestinal bleed, toxic ingestion, and preparation for intubation.<sup>[1,2]</sup> NGT insertion is reported to be among the most painful procedures performed in the ED.<sup>[1,3,4]</sup> Pain is typically experienced as the NGT passes over the highly innervated mucosa of the nasal passages, nasopharynx, and oropharynx. Subsequent triggering of airway reflexes can make proper tube placement difficult and result in increased trauma to the proximal airway.<sup>[2]</sup> Despite this, NGTs are frequently placed with little or no topical anesthetic due to difficulty accessing the affected anatomical structures without similarly causing significant irritation.<sup>[5]</sup> Singer and Konia identified that topical lidocaine and phenylephrine applied to the nasal

### ABSTRACT

**Objective:** Nasogastric tube (NGT) insertion is one of the most painful procedures in the emergency department (ED). A recent study determined that giving intravenous (IV) midazolam before NGT insertion decreased patients' pain; however, the sample size was insufficient to draw the conclusions on safety. We conducted a retrospective chart review of patients who received IV midazolam for NGT insertion to determine the frequency of adverse events. **Methods:** All patients treated at a Level 1 trauma center ED from June 2016 to June 2019 who received IV midazolam for NGT insertion were included. The medical records were screened for the following serious adverse events: hypoxia, respiratory suppression, excessive somnolence/sedation, hemodynamic instability, epistaxis, vomiting, and choking. Adverse events, patient demographics, chief complaint, diagnosis, disposition, number of midazolam administrations, dose per administration, and total dose were recorded for the analysis. **Findings:** Three out of 159 participants (2%) were identified as having an adverse event. In two cases, the adverse event was hypoxia, which was corrected with the administration of supplemental oxygen through nasal cannula. The third adverse event was somnolence noted in a patient who was also hypotensive and in atrial fibrillation around the time of midazolam administration. **Conclusion:** It is safe to premedicate patients with midazolam before NGT insertions. Patients with borderline oxygen saturation and those receiving opioid analgesics may warrant dose titration with close vital sign monitoring.

**KEYWORDS:** Midazolam, nasogastric tube, procedural sedation, safety

passages and combination of tetracaine/benzocaine spray applied to the throat before NGT insertion resulted in significantly less pain than using surgical lubricant alone.<sup>[4]</sup> Other studies have shown that the application of lidocaine gel to the NGT does not result in sufficient anesthetic effect and can cause excitation of the pharynx.<sup>[2]</sup>

Midazolam, a short-acting benzodiazepine, is not only used for the treatment of generalized seizures, status epilepticus, and psychiatric conditions but also increasingly during ED procedures including laceration repair, rapid sequence intubation, and orthopedic

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reductions.<sup>[6]</sup> Its rapid onset, relatively short duration of action, and easy reversal make it ideal for short-term procedural sedation and anxiolysis in the ED.<sup>[2]</sup> Despite its common use, there is little direct evidence to support the safety of midazolam in nasogastric tube insertion. Meta-analyses of procedural sedation techniques suggest overall mean rates of adverse events, such as oxygen desaturation, hemodynamic instability, and need for airway intervention, to be around 1%. However, limited data accounting for the choice of agent, intervention performed, and patient comorbidities preclude safety recommendations.<sup>[5]</sup>

Two prior studies evaluated the use of midazolam specifically for NGT insertion. A study by Manning *et al.* was stopped early due to the clear superiority of intravenous (IV) midazolam in reducing reported pain.<sup>[3]</sup> While there were few adverse events reported in this study, it was insufficiently powered to assess relative rates of adverse events.<sup>[3,7]</sup> Another study evaluated the efficacy of 2 mg oral doses of midazolam in relieving pain in patients requiring NGT insertion, which increased the patient satisfaction after NGT insertion.<sup>[2]</sup> The authors noted an inability to assess the relative safety of midazolam administration and recommended that studies be conducted to assess rates of side effects and adverse events following its use for NGT insertion.<sup>[2]</sup>

The objective of this study was to evaluate the safety of midazolam use for NGT insertion. We conducted a retrospective chart review on patients who underwent NGT insertion in the ED over 3 years. Serious adverse events requiring intervention, such as hypoxia, respiratory depression, and hemodynamic instability, as well as the episodes of epistaxis, vomiting, somnolence, or choking were identified for the analysis.

## METHODS

We performed a single-center retrospective cohort study in the ED of a Level 1 trauma academic medical center with approximately 60,000 annual ED visits. In this ED, nurses routinely place NGTs independently with a verbal or written order for midazolam administration. We adhered to the quality standards of retrospective chart reviews proposed by Worster *et al.* where possible.<sup>[8]</sup> The inclusion criteria were defined as all patients who received IV midazolam before NGT insertion in the ED between June 2016 and June 2019. Patients who received IV midazolam for other reasons or did not have an NGT inserted were excluded from the study. Patients who received midazolam for NGT insertion while intubated and sedated were also excluded from the study. Recorded covariates included age, sex, chief

**Table 1: Baseline demographics**

	n (%)
Sex: female	81 (51)
Age (years), median (range)	62 (1-93)
Chief complaint	
Abdominal pain	96 (60)
Emesis	24 (15)
Nausea	7 (4)
Chest pain	5 (3)
Bowel obstruction*	4 (3)
Diarrhea	4 (3)
Diagnosis categories	
Bowel obstruction	109 (68)
GI bleed	14 (9)
Miscellaneous	13 (8)
Abdominal pain	8 (5)
Malignancy	5 (3)
Disposition	
Admitted	148 (93)
Discharged	11 (7)

\*There were four instances where bowel obstruction was recorded as the chief complaint, entered by nursing in triage. GI=Gastrointestinal

**Table 2: The frequency of observed adverse events in patients given intravenous midazolam**

	n (%)
overall adverse events per patient	3 (2)
Hypoxia	2 (1.3)
Somnolence	1 (0.6)
Hypotension	1 (0.6)
None	156 (98)
Vomiting	0
Epistaxis	0

complaint, diagnosis, and disposition. The exposure of interest was IV midazolam before NGT insertion and the outcome of interest was the rate of adverse events in those patients. Descriptive statistics were calculated using the mean for normally distributed data, median for skewed data, and proportions for the categorical data by a university statistician.

The university's institutional review board approved the study. Electronic medical records of all NGT encounters during the study period who received IV midazolam for NGT insertion were screened for the study. The data management office identified patients who received IV midazolam for NGT insertion using a procedure code for NGT insertion and a medication code for IV midazolam utilizing the medical record database, Epic. Study authors and data abstractors were trained in accordance with institutional standards for data extraction. The first author performed all chart reviews utilizing a standard abstraction form created by the research team. Another

**Table 3: Details of Participants with Adverse Events**

Subject	Adverse event	Age (days)	Comorbidities	Comments
1	Hypoxia	53	Metastatic ovarian/endometrial cancer, DVT/PE, on hospice	No oxygen saturation documented before midazolam, no mention of hypoxia in nursing or physician notes
2	Hypoxia	62	Metastatic ovarian cancer	Oxygen saturation 91% a few minutes before NGT insertion, "tolerated NGT procedure well" in nursing note
3	Somnolence and hypotension	86	Metastatic breast cancer, malnutrition, atrial fibrillation	Unclear when versed was actually given, the patient had thrown up her diltiazem in the morning

DVT=Deep-venous thrombosis, PE=Pulmonary embolism, NGT=Nasogastric tube

member of the research team acted as an interobserver and performed a random analysis of patient charts to monitor for abstractor inaccuracies. Due to the clear nature of the adverse events collected, it was not possible to blind the chart reviewers to the purpose of the study.

Each patient chart was screened for adverse events, defined as hypoxia (oxygen saturation <92%), respiratory depression, hypotension (systolic <90), epistaxis, vomiting, or choking. Nursing notes, physician notes, vital sign logs, and medication administration records while the patient was in the ED were reviewed and recorded. In addition to adverse events, patient age, sex, chief complaint, diagnosis, disposition, administration count of midazolam, dose of midazolam per administration, and total dose were recorded.

## RESULTS

One hundred and fifty-nine participants met the inclusion criteria [Table 1]. The median age was 62 years (range 1–93), and 51% were female. Abdominal pain and emesis were the most common chief complaint (60% and 15%, respectively). The most frequent diagnosis was small-bowel obstruction (65%). About 93% of participants were admitted to the hospital. Total midazolam dose ranged from 0.5 to 5 mg with a median of 1 mg.

Three out of 159 participants (1.8%) were identified as having an adverse event. Two of these participants experienced hypoxia and both received supplemental oxygen through nasal cannula [Table 2]. Participant 1 was a 53-year-old woman with metastatic ovarian/endometrial cancer who presented with emesis and was given 2 mg of IV midazolam before NGT insertion for small-bowel obstruction. The patient was identified as becoming hypoxic through the review of vital sign logs in the electronic medical record, which showed oxygen saturation measured through pulse oximetry to be 88% 4 min after receiving midazolam. Oxygen saturation was not recorded before midazolam administration, and this episode of hypoxia was not documented in nursing or physician notes. Supplemental oxygen through low-flow nasal cannula corrected the

patient's hypoxia as recorded in vital flow sheets. Notably, this patient also received 1 mg of lorazepam 38 min before midazolam administration and two doses of 1 mg hydromorphone 2 h 17 min and 3 h 10 min prior.

Participant 2 was a 62-year-old woman with metastatic ovarian cancer who presented with emesis and received 1 mg of midazolam for NGT insertion following a diagnosis of small-bowel obstruction. This patient was also identified by the review of vital sign recordings from the electronic medical record. The patient did not receive benzodiazepines, opioid analgesics, or other respiratory suppressants before midazolam administration. Oxygen saturation measured through pulse oximetry was 91% before administration of 1 mg of IV midazolam, which decreased to 89% 1 min after midazolam administration. She subsequently received supplemental oxygen through low-flow nasal cannula with improvement of oxygen saturation. The nursing note stated that the patient "tolerated the NG tube procedure well." This patient was hypoxic before midazolam administration according to our hypoxia threshold, but merits consideration in our analysis based on her worsening hypoxia after midazolam administration.

Participant 3 was an 86-year-old woman with metastatic breast cancer, malnutrition, and atrial fibrillation who presented with the chief complaint of constipation. She was identified by the review of physician notes. Following imaging and a diagnosis of small-bowel obstruction, she received 1 mg of IV midazolam for NGT insertion. During the course of her treatment, she experienced an episode of rapid atrial fibrillation requiring two doses of 10 mg of IV diltiazem, an episode of hypotension and of excessive somnolence. It is unclear from documentation whether the hypotensive episode occurred before or after midazolam was administered. This individual was prescribed daily oral diltiazem for a history of atrial fibrillation with rapid ventricular response and reported vomiting her oral diltiazem earlier that day. Oxygen saturation remained >95% throughout the procedure [Table 3].

## DISCUSSION

The key finding in this retrospective analysis of

159 patients who received midazolam for NGT insertion was a low rate (1.8%) of adverse events that were easily managed with bedside maneuvers. Combined with the previous literature showing decreased pain,<sup>[3]</sup> this provides support for the use of IV midazolam to safely reduce discomfort during NGT insertion.

All three participants with adverse events had comorbidities including metastatic cancers. Participant 2 was already hypoxic before the administration of midazolam. Participant 1 had received lorazepam and hydromorphone before administration of midazolam. Sedating medications such as midazolam should be used with caution in critically ill patients with multiple comorbidities and combination with other sedating medications should be used with extreme caution. Overall, midazolam appears to be safe to use in patients with normal oxygenation and normal blood pressures.

This study's strengths include its large sample size and pragmatic nature. We were able to exceed the recommended 100 participants needed to report on the safety profile of IV midazolam for NGT insertions recommended in critiques<sup>[3]</sup> on the previous study by Manning *et al.*<sup>[7]</sup> This study is also pragmatic and applicable to emergency medicine. In this real-world examination of the current practice at our institution for NGT insertions, we found few adverse events. Data supporting the safety of this intervention in this realistic environment are likely to increase the frequency of its use, and therefore, reduce patient's discomfort during this uncomfortable procedure.

This study does have several limitations. As this was a retrospective study of health record data, we can only describe recorded events and relied on the accuracy of nurse and physician charting and vital sign documentation to identify adverse events. Although a thorough chart review was completed using procedure, diagnostic, and medication codes, it remains possible that there are missing records. We did not have a comparison group to be able to reliably identify whether the adverse events were due to midazolam. It is standard practice at our institution to administer 0.5–2 mg of midazolam before NGT insertion based on patient satisfaction demonstrated by Manning *et al.*'s study,<sup>[3]</sup> which would make obtaining a control group difficult.

Another limitation is that some patients received other medications such as opiates and lorazepam before midazolam and NG tube insertion, which may have influenced the adverse event rate and limits precise conclusion on the safety of midazolam as a single agent.

As with any agent chosen for procedural sedation, adequate clinician monitoring in the procedural period is essential for early intervention in any adverse event. Finally, this was a single-center study conducted at Level 1 trauma center. Although our study demonstrated a very low adverse event rate and all adverse events were mild and quickly reversed, hospitals with less staff available to monitor for adverse events should use extra caution with the administration of midazolam.

Our study demonstrates that midazolam is safely tolerated when used for NGT insertions in the ED. Nurses routinely insert NGTs independently with physician orders in place at our institution. Showing that this can be done safely without the use of multiple ED providers or staff supports the feasibility of administering midazolam for NGT insertions to safely decrease patient discomfort in EDs. The few adverse events identified in this study were both complicated by other significant factors and easily corrected with bedside maneuvers. Special attention should be paid to the patients with borderline oxygen saturation and those receiving opioid analgesics, as this may warrant dose titration and appropriate vital sign monitoring.

## AUTHORS' CONTRIBUTION

Jenna Wells: Design, literature search, clinical studies, data acquisition, data analysis, statistical analysis, manuscript preparation, manuscript editing and review. David Murman: Concept, design, definition of intellectual content Alison Sullivan: Guarantor, concept, design, clinical studies, data acquisition, data analysis, statistical analysis, manuscript editing and review.

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## Conflicts of interest

There are no conflicts of interest.

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