JPPT | Case Series

# A Case Series of the Use of Intranasal Dexmedetomidine for Procedural Sedation in the Pediatric Emergency Department

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Procedural sedation in children has the propensity to result in costly hospital admissions and prolonged lengths of stay in emergency departments due to the coordination and resources required for completion. The use of intranasal (IN) dexmedetomidine in children for procedural sedation has been growing in popularity and demand in many clinical settings. Dexmedetomidine is a centrally acting alpha-2 agonist with anesthetic and anxiolytic properties, making it a useful option for sedation. Additional benefits of its use in the pediatric emergency department include high tolerability, decreased emotional distress of children, and ease of administration without need for parenteral access. Of the 18 pediatric patients who received IN dexmedetomidine for procedural sedation, 10 patients had successful procedural sedation solely with IN dexmedetomidine use. The success rate with IN dexmedetomidine was 63% for non-painful procedures (magnetic resonance imaging [MRI], computed tomography [CT]) and 57% for painful procedures (eye examinations, laboratory draw/intravenous [IV] placement, fracture reduction, foreign body removal). There were no documented adverse events with IN dexmedetomidine. Of the 18 patients, only 1 patient needed to return for a repeated scan and 2 patients were admitted owing to sedation needs. The use of IN dexmedetomidine in the pediatric emergency department provides a safe and less invasive option for sedation than commonly used sedatives. This leads to a reduced need for admissions dedicated to obtaining procedural sedation.

**ABBREVIATIONS** CT, computed tomography; ED, emergency department; IN, intranasal; IV, intravenous; MRI, magnetic resonance imaging

**KEYWORDS** dexmedetomidine; intranasal sedation; pediatric emergency medicine; pediatric sedation; procedural sedation

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## Information Box

What specific question(s) does this report address?

We aim to evaluate what dose of dexmedetomidine intranasally is most effective for sedation in the pediatric ED.

What does this report add to our current knowledge?

This report shows that doses closer to 3 mcg/kg most effectively induce adequate sedation for non-painful procedures in the pediatric ED.

## Introduction

In the landscape of pediatric emergency care, the pursuit of safe and efficacious sedation strategies is paramount.[1] The use of sedatives in this context not only is aimed at alleviating distress and discomfort but also is essential for accurate diagnosis and timely treatment, with the ultimate goal of ensuring procedural success. Among the array of sedatives available, dexmedetomidine has emerged as a promising candidate owing to its unique pharmacologic profile and route of administration. Dexmedetomidine works centrally as an alpha-2 agonist, inducing sedation by suppressing the release of excitatory neurotransmitters.[2,3] It has also been suggested that dexmedetomidine has analgesic properties, but it is unclear in current literature how applicable this is to patients in the emergency department (ED) setting.[4] Much of the literature surrounding its use has been in the intensive care setting as an agent for sedation in patients who are intubated, or as an adjunctive agent in combination with other drugs such as midazolam, ketamine, or fentanyl for sedation. As it is investigated further, its utility as a single agent in procedural sedation has been demonstrated.[2,4,5] Intranasal (IN) administration of dexmedetomidine

presents as an attractive option for a few reasons including ease of administration, few adverse effects (e.g., hypotension and bradycardia), and avoidance of invasive procedures such as intravenous (IV) access in patients who do not require IV access for longer-term treatments (e.g., sepsis, long-term antibiotics).[2,5–9] By identifying optimal dosing regimens, and elucidating safety considerations, this case series seeks to enhance procedural sedation protocols, and improve the quality of care and outcomes in the pediatric ED.[10]

## Methods

In September 2023 the pediatric ED at 1 academic medical center began stocking dexmedetomidine in the automated dispensing cabinets for IN administration for patients who require procedural sedation. The pediatric ED team was educated on this new option for procedural sedation including dosing, administration, and patient-specific considerations to guide selection of optimal sedative agents. We describe here a case series of the first 18 pediatric patients during a 4-month period who received IN dexmedetomidine in this pediatric ED. Retrospective chart review was undertaken to collect data including age of patient, body weight, past medical history, dose of IN dexmedetomidine, procedure requiring sedation, timing of drug administration to procedure start and finish, success rate of single-dose IN dexmedetomidine, adverse events, and admission rates required to complete the procedure.

## Results

Of the 18 pediatric patients who received IN dexmedetomidine for procedural sedation, 10 patients had successful procedural sedation solely with IN dexmedetomidine use. The success rate with IN dexmedetomidine was 63% for non-painful procedures (magnetic resonance imaging [MRI], computed tomography [CT]) and 57% for painful procedures (eye examinations, laboratory draw/IV placement, fracture reduction, foreign body removal). The average dosage used for all patients was 2.4 mcg/kg (1–3 mcg/kg), the average dosage for successful completion of procedures solely with IN dexmedetomidine was 2.6 mcg/kg (1–3 mcg/kg), and the average dosage of failed completion with solely IN dexmedetomidine was 2.25 mcg/kg. The average age of successful completion using IN dexmedetomidine was 3.74 years, whereas the average age of failed attempt using IN dexmedetomidine was 6.1 years. There were no documented adverse events for any patients who received IN dexmedetomidine. Of the 18 patients, only 1 patient needed to return for a repeated scan and 2 patients were admitted owing to additional sedation requirements.

**Patient A.** Patient A is a 5-year-old female weighing 16.7 kg with a history of heart failure and renal transplant who required an MRI of the brain for stroke evaluation. She received dexmedetomidine IN 1 mcg/kg, then the MRI was delayed and did not start until 110 minutes after the dexmedetomidine was administered. The imaging was not able to be obtained and the patient was admitted for further sedation and imaging.

**Patient B.** Patient B is an 11-year-old male weighing 83.1 kg with a history of autism and asthma who received dexmedetomidine IN 3 mcg/kg for an MRI of his spine. The IN dose was given 38 minutes prior to the beginning of the MRI scan. The patient was unable to remain still for the entirety of the procedure, and adequate imaging was not obtained in the ED. The patient returned to an outpatient appointment for further sedation and imaging.

**Patient C.** Patient C is a 2-year-old male weighing 11.5 kg who required sedation for a CT scan of the head to assess for head injury after a fall. He received dexmedetomidine IN 1.5 mcg/kg, then 40 minutes later the CT scan began. Adequate imaging was obtained, and the patient was discharged from the ED without additional need for medications.

**Patient D.** Patient D is a 14-month-old male weighing 11.2 kg who received dexmedetomidine IN 3 mcg/kg for a CT scan of the head owing to concerns for head swelling following a fall. The scan began 22 minutes after the IN dose was given. The patient was unable to remain still for the scan, so was also given midazolam IN 0.5 mg/kg 1 hour later to attempt the scan again. Again, the patient was unable to remain still, so 2 hours following the midazolam IN dose he received midazolam 0.5 mg/kg orally and the modality of imaging was changed to x-ray, which was successful.

**Patient E.** Patient E is a 3-year-old male weighing 18.3 kg who required sedation for an MRI of the brain to evaluate neurologic changes. He received dexmedetomidine IN 3 mcg/kg, and the scan began 29 minutes after the medication was given. The sedation was successful and lasted the duration of the procedure, leading to the patient being discharged home.

**Patient F.** Patient F is a 19-month-old female weighing 10.1 kg who received dexmedetomidine IN 3 mcg/kg to obtain an MRI of the brain following trauma to the head. The scan was started 87 minutes after administration of the medication. The patient was unable to remain still, so 72 minutes after dexmedetomidine was given, the patient received midazolam IN 0.5 mg/kg and the MRI was able to be completed successfully, and the patient was discharged.

**Patient G.** Patient G is a 3-year-old male weighing 14.3 kg who required sedation to obtain a thorough eye examination owing to chemical exposure to the eye. He received dexmedetomidine IN 3 mcg/kg and the examination began 4 minutes later. The examination was successful and showed that the eye would need irrigation, so 83 minutes after the dexmedetomidine was given, IV access was obtained and the patient received ketamine IV 1.4 mg/kg for the additional procedure,

which was completed successfully. The patient was discharged from the ED.

**Patient H.** Patient H is an 11-year-old female weighing 67.9 kg with a history of autism, intellectual disability, and behavior abnormalities who required dexmedetomidine IN 3 mcg/kg to obtain difficult IV access. An attempt to secure IV access was made 52 minutes after the dexmedetomidine was administered, however it was unsuccessful. The patient then received midazolam IN 0.15 mg/kg (10 mg) and IV access was successfully obtained. The appropriate workup was successful and the patient was discharged from the ED.

**Patient I.** Patient I is an 8-year-old male weighing 23 kg who required dexmedetomidine IN 3 mcg/kg for a laceration repair following an animal bite. The procedure began 35 minutes following the administration of dexmedetomidine and was completed successfully. The patient was discharged home.

**Patient J.** Patient J is a 4-year-old female weighing 14.7 kg with a history of spina bifida and hydrocephalus and was experiencing headaches, sleepiness, and nausea with vomiting. She required sedation for an MRI of the head. Dexmedetomidine IN 2 mcg/kg was administered and the scan was started 18 minutes later. The MRI scan lasted 18 minutes and sedation was adequate to complete the procedure successfully; however, from the findings of the imaging, the patient was admitted to the hospital.

**Patient K.** Patient K is a 2-year-old female weighing 11.6 kg who required an MRI of the brain for intermittent episodes of hypothermia and ataxia she was having at home. She received dexmedetomidine IN 3 mcg/kg and the MRI began 22 minutes later. The procedure lasted 120 minutes and was successful, and the patient was discharged home.

**Patient L.** Patient L is a 3-year-old male weighing 17.5 kg who required sedation for an eye examination following trauma to the eye. He received dexmedetomidine IN 2.7 mcg/kg and the examination began 20 minutes later. The examination lasted 10 minutes and was successful, and the patient was discharged home.

**Patient M.** Patient M is a 17-month-old male weighing 10 kg who received dexmedetomidine IN 3 mcg/kg for an MRI to evaluate ocular abnormalities. The MRI began 19 minutes after administration of the dexmedetomidine and all images were successfully obtained. The patient was discharged home.

**Patient N.** Patient N is a 5-year-old male weighing 18 kg with a history of sickle cell disease and moyamoya disease that required sedation to obtain MRI, magnetic resonance angiography, and magnetic resonance venography to evaluate for a possible stroke. He received dexmedetomidine IN 2.8 mcg/kg 1 minute before the MRI began. The procedure took 82 minutes to complete and was successful. The patient was admitted to the hospital for monitoring owing to the severity of symptoms that prompted presenting to the ED. No further sedation was required.

**Patient O.** Patient O is a 12-year-old female weighing 46.3 kg with a history of postural orthostatic tachycardia syndrome, chronic migraines, and anxiety who required sedation for an MRI of the brain and spine to evaluate new symptoms of leg weakness. First, she received midazolam IV 0.04 mg/kg; the patient was unable to tolerate the MRI and IV access was lost. Further sedation with dexmedetomidine IN 2 mcg/kg was attempted and the patient was again unable to tolerate the MRI. She was then admitted to the hospital to complete the procedure under full sedation.

**Patient P.** Patient P is a 7-year-old male weighing 51.7 kg who required sedation for the reduction of a fracture sustained after falling onto an arm. About 30 minutes prior to receiving any sedation, he was given acetaminophen 15 mg/kg orally. He received dexmedetomidine IN 1.9 mcg/kg and 16 minutes later the procedure began. The patient did not tolerate the reduction and was given fentanyl IN 1.4 mcg/kg for pain management, then IV access was established and ketamine IV 1.5 mg/kg was given to complete the reduction. The patient was discharged home following the procedure.

**Patient Q.** Patient Q is a 2-year-old male weighing 12.1 kg who required sedation for the removal of a foreign body from the foot. Shortly after presentation to the ED, he was given ibuprofen 10 mg/kg orally, then 90 minutes later received dexmedetomidine IN 1 mcg/kg and an attempt to remove the foreign body was made 13 minutes later. This was unsuccessful. Intravenous access was then obtained, and the patient was administered ketamine IV 1.5 mg/kg, which led to successful removal of the foreign body. The patient was discharged home following the procedure.

**Patient R.** Patient R is a 6-year-old male weighing 56 kg with a history of autism and developmental delay who required sedation for the placement of an IV for hydration and laboratory tests for medical workup. He received dexmedetomidine IN 2 mcg/kg, then 137 minutes later IV access was attempted and successfully obtained. The patient was admitted owing to findings on laboratory tests, but no further sedation was required.

## Discussion

Procedural sedation in the pediatric population is an evolving practice area. The use of IN dexmedetomidine outside of intensive care units has been a catalyst for advancing procedural sedation in pediatric patients.[1,2,4] Within the space of procedural sedation, there are several options to consider, and during the past several years many drug shortages have forced clinicians to use alternative agents, so having this additional option in our procedural sedation tool belt and knowing how to use it optimally is beneficial for the future of pediatric

emergency practice. In this case series, the use of IN dexmedetomidine was successful for both painful and non-painful procedures for completion of procedural sedation.

When selecting which medication or combination of medications to use for a procedural sedation, considering the onset and duration is vital. Dexmedetomidine IN has an onset of about 20 minutes but does not reach peak effect for up to 30 to 40 minutes from administration and can have a duration of 45 to 60 minutes. Comparing this with other IN and IV options, the onset of dexmedetomidine is not optimal for urgent procedures. For the patients in this case series, 6 (patients A, C, D, F, H, and R) had delays in the procedure of more than 40 minutes from the time of administration of dexmedetomidine, and 4 (patients A, D, F, and H) of those 6 procedures required additional sedation or admission for full sedation to complete the procedure. Coordination of timing of administration, start of the procedure, and duration of the procedure are all important to consider with IN dexmedetomidine use. Regarding dosing, various doses have been studied, ranging from 1 to 4 mcg/kg for IN use. One study evaluated 109 patients ranging in age from 6 months to 18 years and found that doses of 3 mcg/kg of dexmedetomidine alone, or dexmedetomidine IN combined with midazolam IN, had a 92% success rate.[7] Another systematic review evaluating dexmedetomidine use in the ED included 3 studies addressing procedural sedation. Within that review, dexmedetomidine showed more rapid onset to adequate sedation in some studies, and less favorable onset in others, along with several studies with risk of bias, thus emphasizing the need for further studies in this area.[4]

Through review of the patients within this case series, a few opportunities that may lead to increased rates of success were identified. In this small case series, less success was seen in patients who required sedation for painful procedures. This is likely multifactorial; however, of the patients whose sedation was unsuccessful, none received adjunctive pain medication prior to the procedure. Two of the patients whose sedation was successful for a painful procedure received acetaminophen or ibuprofen 30 to 90 minutes prior to the procedure and had success. Pain management in the pediatric population is often difficult to recognize and manage but is influential in the success of the procedure and comfort of the patient. Routine assessment of the patient's pain, using pediatric-specific tools such as Wong-Baker FACES or Faces Legs Activity Cry Consolability Scale in younger children and Numerical Rating Scale in older children, can aid in determining the need for additional adjunctive therapies to improve success rates in these patients.[11,12]

Another factor identified, which may have influenced the success of procedures, lies within the considerations for IN medication administration. One consideration is that the nasal atomizer has a dead space of up to 0.1 mL, meaning that up to 0.1 mL of the medication may be retained in the atomizer. To overcome this, nurses are instructed to draw up an additional 0.1 mL of the medication they are administering.[13] It is also important to recognize the limits of IN absorption of medication. The largest limitation is the volume of medication required; both large volumes and very small volumes can lead to impaired absorption of the optimal dose. The maximum volume that should be used is 1 mL per nostril in larger children, and 0.5 mL per nostril in infants and smaller children. Because of this limitation, when using dexmedetomidine it is beneficial to use the most concentrated product available, which for dexmedetomidine is a 100-mcg/mL vial preparation. Specifically, the maximum weight limitation for an intranasally absorbable 3-mcg/kg dose is about 66 kg. In patient B in our case series, the dose administered equated to a total volume of 2.5 mL and the sedation was not successful. While there were other factors that may have contributed, the large volume required for the desired dose was likely contributory. On the other side, small volumes of medication may be less reliable because the nasal atomizer can retain approximately 0.1 mL of the drug being administered. Patients A, C, and Q received doses that were less than 0.2 mL, and one required administration of ketamine to complete the procedure successfully. There may have been other factors contributing to this, but in cases where the volume is ≤0.2 mL, it is especially important to ensure that an additional 0.1 mL of the medication to be administered is drawn up to account for the dead space in the atomizer and to ensure maximal drug delivery and absorption. It is unknown in these 3 patients whether there was additional dexmedetomidine drawn up to account for the dead space in the atomizer.

## Study Limitations

This case series favored success in a younger patient population; however, a larger cohort is required to definitively ascertain trends regarding ideal patient population for successful use of IN dexmedetomidine. Owing to the retrospective nature and small number of patients included in this descriptive case series, there are potential limitations with documentation and extraction of information collected. Data analysis was limited to information available in the electronic medical record, and adverse events potentially may have been underreported.

## Conclusion

This case series illuminates the use of IN dexmedetomidine in a pediatric ED to provide a safe and less invasive option for sedation. Through this limited case series, the use of IN dexmedetomidine led to a reduced need for admissions dedicated to obtaining

procedural sedation, thus alleviating both financial and resource burdens of the health care system. Intranasal dexmedetomidine provides a safe, less invasive, and tolerable option for pediatric procedural sedation in the ED. Future research is warranted to further evaluate optimal dosing, safety, and cost effectiveness.

## Article Information

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**Ethical Approval and Informed Consent.** The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant international guidelines on human experimentation and have been approved by the appropriate committees at our institution. However, given the nature of this study, informed consent was not required by our institution.

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