Dexmedetomidine for Transport of a Spontaneously Breathing Combative Child

abstract

Interhospital transport presents a challenge for pediatricians, and airway protection is often a significant concern. The severely agitated child without respiratory compromise poses an extremely difficult dilemma, as most sedative agents can cause respiratory depression. Intubation offers definitive control of the airway but is not without risk, especially in an environment where experience and resources for pediatric intubation may be limited. Dexmedetomidine may be used for sedation in certain circumstances for the transport of a child without the need for intubation and mechanical ventilation. *Pediatrics* 2012;130:e690–e694

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KEY WORDS

dexmedetomidine, interhospital, transport, ingestion, altered mental status

ABBREVIATIONS

BP—blood pressure

ED—emergency department

FDA—Food and Drug Administration

HR—heart rate

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Interhospital transport presents a common challenge for pediatricians, and airway protection is often a significant concern. The severely agitated child without respiratory compromise poses an extremely difficult dilemma. In many circumstances, these patients require sedation and intubation before transport for the safety of the patient and transport crew. Intubation in children is not without risk, however, especially in an environment where experience and resources for pediatric intubation may be limited.^{1,2} Along with the intrinsic risks of intubation, complications related to mechanical ventilation can be encountered during transport,^{3,4} and may contribute to increased morbidity and prolonged hospitalization. Sedation without intubation represents an alternative approach to the management of the severely agitated child, but the most commonly used sedative agents may be unpredictable and can lead to respiratory depression. Dexmedetomidine, however, is a potent α -adrenergic agonist that provides sedation and anxiolysis without depressing the respiratory drive.^{5–7} We report the first case of the use of dexmedetomidine to successfully sedate and transport a child with severe drug-induced agitation without the need for intubation and mechanical ventilation.

CASE REPORT

A 5-year-old boy with history of attention-deficit/hyperactivity disorder, oppositional defiant disorder, and bipolar disorder presented to a regional hospital with acute agitation. The child had failed multiple medical regimens to treat his psychiatric disorders and was started on lisdexamfetamine dimesylate and olanzapine the day before presentation. Shortly after taking these new medications, he became acutely agitated with hallucinations, combativeness, and self-injurious behavior. These symptoms were treated at home

with diphenhydramine, but when the child did not improve, he was taken to a regional emergency department (ED). The ED physician contacted the poison control center physician who recommended treatment of the agitation with benzodiazepines as needed. The patient was initially treated with a dose of 1 mg of lorazepam; however, the boy remained combative and over the next 12 hours in the ED he received additional doses of lorazepam and midazolam totaling 20 mg (1.3 mg/kg) and 1 mg (0.07 mg/kg), respectively. Despite these escalating doses of benzodiazepines, the boy remained combative with behavior that was difficult to control. The patient's behavior was felt to be potentially injurious to himself, his family, and the medical staff, prompting the ED physician to request transfer to our PICU for further care and monitoring.

Given the unclear etiology and trajectory of the patient's altered mental status, and in attempt to minimize the patient's transport time, it was decided to transport the patient by air using a pediatric critical care transport team. When the transport team arrived at the referring hospital ED, the boy remained extremely agitated. Otherwise, he had a reassuring exam, and vital signs included the following: heart rate (HR), 100 beats per minute; blood pressure (BP), 104/50 mm Hg; respiratory rate, 24 breaths per minute; and oxygen saturation, 100% on room air. Given the continued agitation and combativeness, the team felt it was unsafe to transport the patient without either intubation or significant sedation.

Under guidance from the medical control physicians in the receiving PICU, the transport team administered an intravenous bolus dose of 0.5 μ g/kg dexmedetomidine to treat the patient's agitation. This dose was followed with a continuous infusion of dexmedetomidine (0.2 μ g/kg/h). Within 20 minutes, the patient became compliant and was

resting comfortably. His vital signs remained unchanged (HR 111, BP 94/54, respiratory rate 26, oxygen saturation 98%). After an additional 10 minutes of observation, the transport team loaded the child. During transition to the transport stretcher and loading of the helicopter, there was no agitation, and vital signs remained unchanged. During the first few minutes of air transport, ~30 minutes after completion of dexmedetomidine bolus, the child's BP decreased to 67/33. The dexmedetomidine infusion was briefly discontinued, and the patient was administered 10 mL/kg of intravenous normal saline. Blood pressure improved to 90/53 after fluid administration and temporary discontinuation of dexmedetomidine. Approximately 5 minutes after completion of the normal saline fluid bolus, the child became restless, and the dexmedetomidine infusion was restarted. After reinitiation of dexmedetomidine, the patient remained calm with stable BPs in the 74 to 102/41 to 56 mm Hg range for the remainder of the hour-long transport. The child maintained an adequate spontaneous respiratory effort throughout transport, and his HR remained unchanged (98–102 beats per minute).

Over the course of the next 20 hours in the PICU, dexmedetomidine was weaned and then discontinued. Forty-three hours after the initial dose of lisdexamfetamine and 53 hours after the olanzapine, the child returned to his baseline neurologic state without the need for dexmedetomidine or other sedating agents. His total treatment time with dexmedetomidine, including transport, was 19.5 hours. He was observed for a short period after dexmedetomidine discontinuation and was ultimately discharged from the hospital with close outpatient follow-up.

DISCUSSION

This is the first report of dexmedetomidine to treat acute agitation during

transport of an extubated pediatric patient. Dexmedetomidine does not depress the respiratory drive,^{5,7} making it a potential option for the transport of extubated patients. Although there are no reports of dexmedetomidine use in the out-of-hospital environment, there are several prospective trials evaluating its use for procedural sedation in spontaneously breathing children.^{8–11} In 4 trials, dexmedetomidine was given to a total of 180 children who ranged in age from 5 months to 16 years. Each child in these studies received an intravenous loading dose (0.5–2.0 $\mu\text{g}/\text{kg}$) followed by an infusion (0.5–1.0 $\mu\text{g}/\text{kg}/\text{h}$). In almost all cases, there was a statistically significant but not clinically important decrease in HR and BP. There were no clinically important effects on respiration in any patient. The degree of sedation required during procedural sedation is analogous to the depth necessary to ensure safe inter-hospital transport, creating a new potential application for dexmedetomidine. At this time, there is no Food and Drug Administration (FDA) label for dexmedetomidine use in children. Dexmedetomidine is FDA approved for short-term sedation (<24 hours) in mechanically ventilated adults in the ICU. Despite the lack of FDA labeling in pediatrics, dexmedetomidine has become a widespread therapeutic option for children in the PICU and operating room settings.¹² Multiple trials have examined dexmedetomidine to sedate mechanically ventilated children,^{13–16} to prevent emergence delirium after general anesthesia,^{17–20} and for both invasive^{21,22} and noninvasive^{8–11} procedural sedation.

Sedation with dexmedetomidine is achieved via α -adrenergic agonism, as with clonidine, but dexmedetomidine is much more potent owing to its higher specificity for the α_2 -receptor.²³ Dexmedetomidine works via a G protein-regulated pathway that blunts the sympathetic response to create the

desired clinical effects of sedation and anxiolysis.²⁴

Even though dexmedetomidine does not affect respiratory drive, the ubiquity of α -receptors throughout the body leads to other end-organ effects. The most pronounced and often dose-limiting of these side effects are hypotension and bradycardia, which occur in adults at rates of 28% and 7%, respectively.²⁵ In rare cases, sinus arrest has been reported.^{26,27} Hypotension and bradycardia appear to occur at lower rates in children. In 1 large trial of more than 1200 children, the reported incidence of hypotension was 2.2%, and in another trial of dexmedetomidine in 315 children with behavioral disorders, the incidence of hypotension and/or bradycardia was <3%. Although uncommon, hypotension and bradycardia, when they do occur, appear to be dose-related, and a 30% decrease in BP and HR after a load of 1 $\mu\text{g}/\text{kg}$ given over 10 minutes has been reported.^{28,29} Other reported side effects include transient hypertension associated with a loading dose, nausea, and dry mouth.³⁰

Our experience with dexmedetomidine, knowledge of the pediatric data, and the fact that this patient represented a threat to both himself and the medical air transport team, led to the decision to sedate this severely agitated and combative child with dexmedetomidine for transport. An alternative approach would have been to attempt to avoid intubation and mechanical ventilation by using the calming presence of a family member during ground transport; however, transport by ground in this circumstance would likely have been ineffective given the inability of the family to calm the patient for several hours in the referring ED. In this case, a prolonged ground transport (>3 hours), the persistent agitation despite family presence, and unclear trajectory of the child led to the decision to minimize out-of-hospital time by using

air transport. By using dexmedetomidine, we were able to safely transport this child via air without intubation and mechanical ventilation.

Although this patient experienced transient hypotension, likely related to dexmedetomidine, the risk of additional intravenous fluids in this context seems minimal. As in this case, an adjunct (or alternative) to fluid resuscitation, is discontinuation of the dexmedetomidine infusion. An important consideration in this circumstance is that dexmedetomidine has a rapid distribution phase with a short distribution half-life (6 minutes), but a prolonged terminal elimination half-life of 2 hours. Vasoactive agents (eg, dopamine, epinephrine) are second-line therapy for treatment of dexmedetomidine-related hypotension, but should be used with caution during transport in a child without central vascular access.³¹

It is also important to note that hypotension may result during intubation, either from associated sedation administration or the transition to positive pressure ventilation. Although the risk of hypotension is a consideration with the use of dexmedetomidine, the risk between potential hemodynamic compromise versus intubation and ventilation must be carefully considered when faced with the need to transport an acutely agitated child with effective spontaneous breathing.

This patient's overall hospital stay was likely shortened as a result of transport without intubation, as a longer period would have been necessary in the PICU for extubation and post-extubation monitoring. In this case, he was able to be discharged within a day of arrival to our institution. This case demonstrates that with careful patient selection, dexmedetomidine may be safely used as a treatment of agitation in a spontaneously breathing child, but additional work remains to fully determine the clinical pharmacology

and impact of dexmedetomidine in children. Dexmedetomidine may be applicable in select circumstances when the interhospital transport of agitated patients is necessary, with careful consideration of the risks and benefits of sedation, spontaneous respiration, and intubation/mechanical ventilation on a case-by-case basis.

CONCLUSIONS

This case represents the first report of dexmedetomidine for sedation in a spontaneously breathing patient during interhospital transport. Dexmedetomidine represents a potential therapeutic option for the acutely agitated patient in need of transport, and the use of this agent may allow for

avoidance of intubation and mechanical ventilation. However, the risks and benefits of intubation versus the maintenance of spontaneous respiration during transport should be carefully considered for each individual patient to determine the safest course of action for both the patient and transport team.

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