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Dexmedetomidine for Anterior Mediastinal Mass Computed Tomography-Guided Biopsy: A Case Series

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ABSTRACT

Background: Sedation of children undergoing biopsies of anterior mediastinal masses can be challenging because of the absolute necessity of ensuring minimal smooth muscle relaxation and preventing airway collapse. Furthermore, positive pressure ventilation may be difficult or impossible and may also pose the additional risks of hemodynamic compromise in the pediatric patient.

Case Reports: We present a case series of 3 children who were successfully sedated for computed tomography (CT)-guided mediastinal biopsies with dexmedetomidine.

Conclusion: Dexmedetomidine, a selective alpha-2 adrenoreceptor agonist that maintains the smooth musculature of the pediatric airway, provides the ability to sustain spontaneous ventilation in patients with airway compression. Dexmedetomidine is a safe, reliable anesthetic for biopsy of children with anterior mediastinal masses.

INTRODUCTION

Children with anterior mediastinal masses (AMM) can be extremely challenging for the pediatric anesthesiologist. Maintenance of adequate airway architecture with minimal smooth muscle relaxation and prevention of collapse is vital. Compression of the mediastinal structures by bulky masses may make positive pressure ventilation difficult or impossible and may also pose additional risks of hemodynamic compromise in this patient population. Therefore, spontaneous ventilation is considered essential for safe anesthesia administration.

Dexmedetomidine, a highly selective alpha-2 agonist that has both sedative and analgesic properties,[1–4] is a suitable sedation agent for radiologic imaging studies.[5,6] Hemodynamic effects in adults and children are modest.[7] A recent report of 2 adults with significant AMMs undergoing sedation showed that dexmedetomidine allows for significantly stimulating procedures to be safely performed.[8] We present a case series of pediatric patients who were successfully sedated for computed tomography (CT)-guided mediastinal biopsies.

CASE 1

A 50.2 kg, 13-year-old male had a history of a neck mass for 2 months. Despite his compromised borderline respiratory status, he tolerated an uneventful CT scan of the chest that showed a large 10.6 × 6.9 cm mass compressing the superior vena cava and trachea. After appropriate further work-up—including echocardiogram and consultation with the oncology, surgery, and interventional radiology services—the decision was made to proceed with a sedated CT-guided biopsy for diagnostic purposes. The patient was positioned supine on the CT table, a nasal cannula was placed, and the patient continued spontaneous ventilation on 28% FiO_2. After intravenous (IV) administration of 1 mg midazolam, dexmedetomidine was gradually bolused IV 3 times in doses of 0.5 mcg/kg over 5 minutes until the patient achieved an adequate level of sedation. Local anesthesia was infiltrated into the chest wall, and the biopsy was performed uneventfully with the patient maintaining spontaneous ventilation throughout. The pathology report showed stage IIA Hodgkin lymphoma for which the patient

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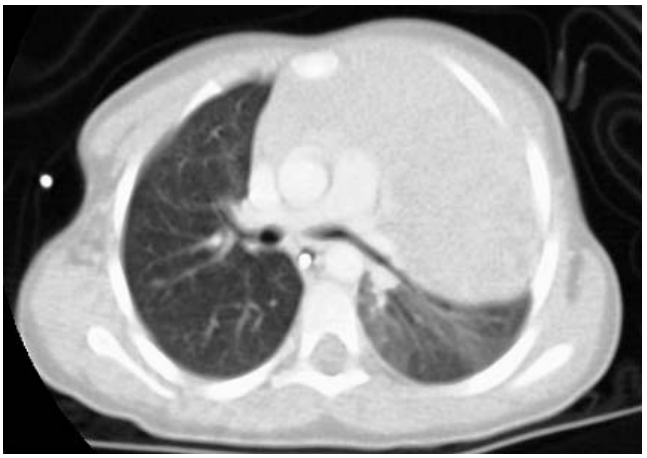

Figure 1. Computed tomography scan showing a bulky anterior mediastinal mass compressing the left bronchus of the patient described in case 3.

underwent chemotherapy and had a complete remission.

CASE 2

A 44.6 kg, 12-year-old male had a history of chest pain for 2 weeks. The patient denied dyspnea or orthopnea. A CT scan revealed a 9.8 × 8 × 10.6 cm AMM that was completely obstructing the left pulmonary artery and left mainstem bronchus. For his biopsy, the patient was placed supine on the CT table with oxygen support of 2 L via nasal cannula. Midazolam 1 mg was given twice IV for anxiolysis. Two 5-minute boluses of dexmedetomidine, 0.25 mcg/kg and 0.5 mcg/kg, and a ketamine 0.5 mg/kg bolus were subsequently given IV to ensure adequate analgesia and sedation before the procedure began. A local anesthetic (1% lidocaine) was infiltrated into the chest wall, and the biopsy was performed without complications. The pathology report was consistent with T-cell lymphoma for which the patient is currently in remission after chemotherapy.

CASE 3

An AMM measuring 6.0 × 7.0 × 7.6 cm (Figure 1) was found in an 8.7 kg, 23-month-old female during the workup for her failure to thrive. The family noted that the patient was able to lie flat at home with no difficulty or alterations in breathing. Because she was slightly agitated upon her arrival into the radiologic suite, she was given ketamine 1 mg/kg IV, followed by midazolam 1 mg IV, slowly titrated to allow her to calmly lie supine on the CT table for her CT-guided AMM biopsy. The parents were then escorted out of the radiologic suite. A dexmedetomidine infusion was started at 0.7 mcg/kg/h and raised to 1 mcg/kg/h to induce deep sedation for the infiltration of a local anesthetic (1% lidocaine). Although the biopsy was uneventful, a rather large pneumothorax (Figure 2) required the placement of 2 pig-tailed catheters postbiopsy. No hemodynamic changes were noted, and the patient tolerated this second procedure well. The chest catheters were removed 2 days later, and the pathology report was consistent with benign thymic hyperplasia. The tumor was completely removed 10 days later without complications.

Figure 2. Computed tomography (CT) scan showing a left pneumothorax following CT-guided biopsy of the anterior mediastinal mass in the patient described in case 3.

DISCUSSION

Dexmedetomidine, a selective alpha-2 adrenoreceptor agonist, is a sedative with growing experience in the pediatric population. Besides its analgesic and sedative properties, dexmedetomidine has a minimal impact on respiratory parameters, making it potentially an ideal drug for patients with respiratory compromise. To achieve an adequate level of deep sedation, the 3 patients in this case series required a combination of dexmedetomidine and midazolam, with the addition of ketamine for the third patient. Anesthetic depth for each of the patients was maintained with an infusion of dexmedetomidine. All patients received injection of subcutaneous lidocaine and underwent the CT-guided biopsy uneventfully. The patient described in case 3 developed postbiopsy pneumothoraces but never developed signs of a tension pneumothorax, in part because the child was breathing spontaneously and positive pressure was not utilized for ventilation. Finally none of the children developed hypotension or bradycardia. The noninfant patients woke up in the recovery room with no recollection of the biopsy.

In 2 recent adult cases, dexmedetomidine was used as the maintenance anesthetic for bronchoscopic insertion of bronchial stents.[8] This adult population is similar to the pediatric AMM population that requires a tissue biopsy to determine the definitive medical or surgical management. Airway obstruction in AMM patients undergoing general anesthesia is dangerous for 3 reasons: (1) relaxation of the smooth muscle surrounding the trachea under general anesthesia can lead to collapse of the trachea; (2) lung volumes are reduced in patients with AMMs; and (3) loss of spontaneous diaphragm movement decreases the transpleural pressure gradient, leading to a decrease in airway diameter.[8,9] Preventing these complications requires a detailed anesthetic plan that allows for spontaneous ventilation while keeping lung volumes elevated, even in the supine position, and that would not cause relaxation of the smooth muscle of the trachea. Recently, upper airway morphology in spontaneously breathing healthy children undergoing magnetic resonance imaging (MRI) has been studied.[10] Clinically modest dynamic and static changes were seen in the airway with increasing doses of dexmedetomidine. The authors concluded that the airway changes are small and do not appear to be associated with clinical signs of airway obstruction.[10] Another report showed no evidence of airway obstruction in patients with obstructive sleep apnea and trisomy 21 who had MRI evaluations using dexmedetomidine and ketamine.[11]

CONCLUSION

Our case series shows that by maintaining airway smooth muscle tone and spontaneous ventilation, dexmedetomidine is a safe, reliable anesthetic for biopsy of children with AMMs. Dexmedetomidine is ideally suited for providing an adequate level of sedation for many types of procedures. This novel approach to the pediatric patient with an AMM demonstrates another use for this medication in pediatric anesthesia.

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