Dexmedetomidine for Sedation in the Parturient With Respiratory Failure Requiring Noninvasive Ventilation

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Dexmedetomidine is a selective alpha-2 receptor agonist that possesses both sedative and analgesic properties, with minimal respiratory depression. We report the successful administration of dexmedetomidine on a 16-year-old primigravida woman that allowed the patient to tolerate application of bi-level positive airway pressure ventilation in treatment of acute hypoxemic respiratory failure.
Key words: respiratory distress; noninvasive ventilation; NIV; pregnancy; dexmedetomidine. [Respir Care 2012;57(11):1967–1969.

Introduction

Effective sedation can often be difficult to achieve in the parturient. Many of the drugs currently utilized for sedation in the ICU can cause undesirable respiratory effects, as well as teratogenicity. For example, propofol's lipophilic characteristics also increase the amount of drug transfer across the placenta. It also is known to have sedative effects on the neonate; studies suggest that plasma levels of propofol in the neonate are dependent on the maternal dose and plasma levels.[1] Finally, propofol has profound respiratory depressant properties.[2] Benzodiazepines such as midazolam are used for sedation in critical care settings, but can result in substantial accumulation of drug levels.[2] Anecdotal evidence also suggests that exposure to benzodiazepines may result in congenital malformations.[3] Fentanyl is highly lipophilic and is rapidly transferred across the placenta by diffusion and can be detected in the fetal brain.[1] Fentanyl is also associated with neonatal respiratory depression and neurobehavioral changes.[1] Finally, like propofol, fentanyl can cause substantial respiratory depression. Newer studies suggest a possible role for short-acting opiates such as remifentanil in sedation during noninvasive ventilation (NIV).[4]

In contrast to these medications, dexmedetomidine is a selective alpha-2 receptor agonist that possesses analgesic and sedative properties, with minimal respiratory depression. It is metabolized by the liver and renally excreted as methyl and glucuronide conjugates. It is currently used for sedation in the intensive care setting, as well as an adjunct for anesthesia and analgesia during procedures. Hemodynamic side effects of dexmedetomidine include dose-dependent decreases in blood pressure, heart rate, and plasma catecholamine concentrations.[5] It is classified as a class C medication in pregnancy, as there are currently no adequate or well controlled studies in pregnant women. Additionally, most of the studies on dexmedetomidine exclude pregnant patients. However, current research shows that, as compared with clonidine, there is minimal placental transfer.[6] This is because there is rapid clearance of dexmedetomidine from the maternal circulation and greater placental tissue retention, which results in less placental transfer of the drug to the fetus. Additionally, there is one study in rats that reports no important effect on postnatal weight gain, behavioral performances, and motor activity after acute exposure to dexmedetomidine in utero.[7]

We report the successful management of a parturient with severe aspiration pneumonia who was sedated with dexmedetomidine to tolerate noninvasive bi-level positive airway pressure ventilation (BPAP).

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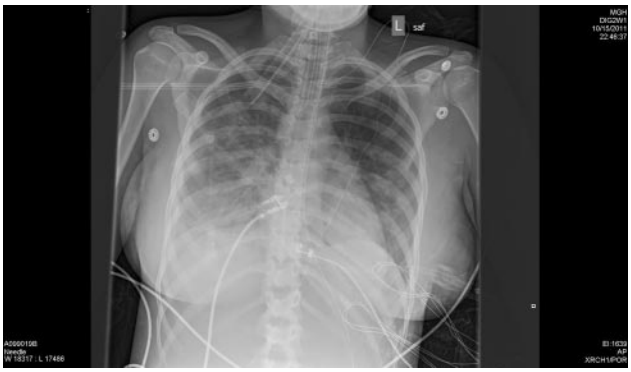

Fig. 1. The figure depicts the x-ray revealing peribronchial cuffing with trace pleural fluid.

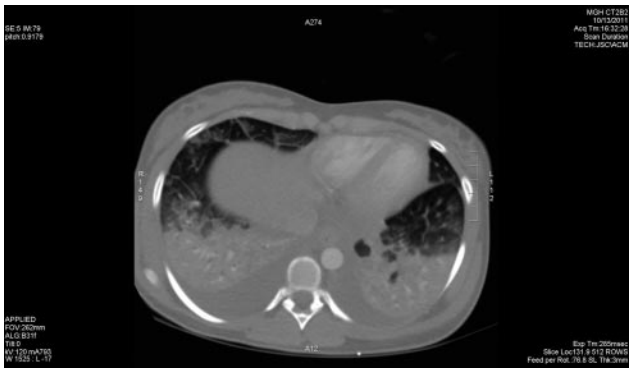

Fig. 2. The figure depicts one section of the patient's computed tomography scan revealing diffuse multifocal solid and ground glass opacities throughout both lungs.

Case Report

A 16-year-old gravida 1, para 0 woman with no noteworthy past medical history presented in preterm labor at 31 weeks and 6 days, during an otherwise uncomplicated gestation. She was started on magnesium for tocolysis and fetal neuroprotection, and was given a course of 2 doses of betamethasone. An epidural catheter was placed for analgesia when it was felt that her labor was progressing. On her second hospital day, the patient's oxygen saturation dropped below 90%, which resolved with rest and deep inspiration. She eventually required 2 L/min supplemental oxygen via nasal cannulae. A chest x-ray at that time (Fig. 1) showed no evidence of pulmonary edema. However, the patient's oxygen requirement continued to increase such that she required 4 L/min via nasal cannulae to maintain her oxygen saturation above 90%. She was also given furosemide for diuresis when it was noted that she was 3 liters positive since her admission.

In spite of a 2-liter diuresis, her respiratory status continued to worsen. A pulmonary-embolism protocol computed tomography (Fig. 2) was performed that revealed no pulmonary embolus, but instead showed diffuse multifocal solid and ground glass opacities, concerning for atypical pneumonia, possibly fungal or mycobacterial in etiology. Her temperature increased to 38.1°C and her heart rate increased to 130–140 beats/min. She continued to decompensate, and eventually required F_{IO_2} of 0.40 through a non-rebreather mask. Her respiratory rate ranged from 26 to 30 breaths/min, and arterial blood gas analysis at that time revealed a pH of 7.50, P_{aCO_2} of 33 mm Hg, and P_{aO_2} of 85 mm Hg. Her P_{aO_2}/F_{IO_2} was 212 mm Hg. Her epidural catheter was removed for concern of sepsis, and she was transferred to the ICU for further management of her respiratory distress.

In the ICU, broad spectrum antimicrobials were initiated, including azithromycin, cefepime, vancomycin, metronidazole, oseltamivir, and amphotericin B. Blood work was sent to evaluate for bacterial, viral, microbacterial, and fungal infections. Her human immunodeficiency virus test was negative. She was placed on BPAP (V60, Philips Respironics, Murrysville, Pennsylvania), S/T Mode, 10/5 cm H_2O, F_{IO_2} 1.0, oronasal mask, respiratory rate 12 breaths/min, inspiratory time 0.8 s, inspiratory trigger flow 3 L/min, ramp time off, rise time setting 2, to reduce her work of breathing and to improve oxygenation. However, the patient did not tolerate BPAP, secondary to anxiety and agitation. Attempts to improve her hypoxemia were unsuccessful with F_{IO_2} 0.70 by high-flow face mask, and her respiratory status continued to deteriorate.

At that time arterial blood gas analysis revealed a pH of 7.45, P_{aCO_2} of 34 mm Hg, P_{aO_2} of 92 mm Hg, and a respiratory rate of 30 breaths/min. It was felt that NIV might be successful with sedation, so dexmedetomidine 0.2–1.4 μg/kg/h was started. It was titrated to a Richmond Agitation Sedation Scale score[8] of 0. She tolerated BPAP after a dexmedetomidine infusion was initiated, and her respiratory distress and hypoxemia improved. Arterial blood gas analysis at this time showed a pH of 7.45, P_{aCO_2} of 33 mm Hg, and P_{aO_2} of 157 mm Hg, a P_{aO_2}/F_{IO_2} of 157 mm Hg, and a respiratory rate of 24–30 breaths/min.

The patient's P_{aO_2} remained stable while she remained on BPAP. On ICU day 1 the patient rapidly progressed and she was transferred to the operating room for delivery. While the patient remained comfortable on BPAP, she was intubated to facilitate labor. In the operating room she underwent a low forceps assisted vaginal delivery. The male infant's Apgar scores at 1 and 5 min were 7 and 8, respectively. Her epidural catheter was removed after the delivery, and she was transferred back to the ICU. After intubation, a bronchoscopy was performed that revealed moderately erythematous airways, with no purulence or frank aspirated material.

The patient was rapidly weaned from the ventilator and extubated without incident. All of the patient's laboratory

data returned negative, and her antibiotics were discontinued. She was discharged from the hospital on hospital day 7, and, upon follow up at the clinic, both the patient and her baby were doing well.

Discussion

We report the successful administration of dexmedetomidine on a 16-year-old primigravida woman, that allowed the patient to tolerate application of BPAP. Sedation for facilitation of NIV is unusual when NIV strategies have been optimized. However, it can be useful in situations where the patient is unable to tolerate NIV in spite of these strategies. In the case presented we were reluctant to use narcotics or other sedative agents, given the patient's tenuous respiratory status and concern for respiratory depression.

There is a paucity of literature both in the use of dexmedetomidine during NIV as well as during the need for sedation in pregnancy. Takasaki et al reported the successful use of dexmedetomidine to facilitate NIV in 2 cases of severe asthmatic exacerbations, during which the patients were initially too agitated to tolerate NIV.[9] In this report, a bolus of dexmedetomidine at 3 μg/kg/h for 10 min was given, followed by an infusion at 0.2–0.6 μg/kg/h. Both patients tolerated NIV within one hour of initiating dexmedetomidine. A small prospective study of 10 patients with acute respiratory failure evaluated the use of dexmedetomidine for sedation during the treatment with NIV.[10] In this study, all 10 patients achieved a target sedation score (Richmond Agitation Sedation Scale of 0 or less) within 1 hour of initiation of dexmedetomidine, and it did not cause any substantial hemodynamic changes in the patients.

The existing literature on the use of dexmedetomidine in the parturient population consists of a few case reports of the use of dexemedetomidine to help facilitate awake fiberoptic intubations, and also as adjunctive analgesia for labor during caesarian sections.[11,12] One case report describes the use of dexmedetomidine during emergence from anesthesia after a cesarean section in a patient with pulmonary hypertension.[13] Additionally, there are descriptions in the literature of using dexmedetomidine in preeclamptic and eclamptic patients, where dexmedetomidine has been reported to raise the seizure threshold while controlling the patient's blood pressure.[14]

We believe that dexmedetomidine may be a useful in pregnant patients who require sedation for NIV. Further randomized controlled studies are warranted.

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