CASE REPORT

Dexmedetomidine for awake fiberoptic intubation in a parturient with spinal muscular atrophy type III for cesarean delivery

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ABSTRACT
Spinal muscular atrophy in pregnancy is rare and poses multiple problems for the anesthesiologist. The effects of dexmedetomidine on a parturient with spinal muscular atrophy have not previously been reported. There are also no in vivo data on placental transfer of dexmedetomidine and its effects on a human neonate. We report the hemodynamic, respiratory and sedative effects of dexmedetomidine on a parturient and neonate when used for awake fiberoptic intubation before cesarean section. A 35-year-old, gravida 4 para 0 aborta 3, 41-kg parturient at 35 weeks of gestation with spinal muscular atrophy presented for cesarean section. Dexmedetomidine was administered intravenously, total dose 1.84 μg/kg over 38 minutes, followed by fiberoptic endotracheal intubation. Dexmedetomidine was then discontinued and general anesthesia was induced. The baby was delivered 68 minutes after the dexmedetomidine infusion was discontinued at which time blood samples were obtained for measurement of dexmedetomidine. During administration of dexmedetomidine, maternal heart rate, blood pressure and oxygen saturation remained stable. Apgar scores at 1 and 5 min were 6 and 8. The fetal concentration of dexmedetomidine (540 pg/mL) indicates significant placental transfer, but significant adverse neonatal effects were not observed. Dexmedetomidine alone provided adequate sedation for awake intubation without respiratory compromise in this patient.

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Keywords: Spinal muscular atrophy; Pregnancy; Cesarean section; Awake fiberoptic intubation; Dexmedetomidine; General anesthesia

Introduction
Spinal muscular atrophy (SMA) has an estimated incidence of 1:10 000 in the general population,1 and is rare during pregnancy. A case report identified 23 pregnancies in 18 women from 1966 to 1999.2 SMA, an inherited motor neuron disease, causes progressive degeneration of spinal cord anterior horn cells. It is characterized by diffuse voluntary muscle weakness and subsequent muscle atrophy, respiratory muscle insufficiency and scoliosis.2,3 These patients present multiple problems for the anesthesiologist including airway difficulties, respiratory compromise and spinal abnormalities. Multiple case reports describe anesthesia and analgesia for parturients with spinal muscular atrophy.3–7 Dexmedetomidine, a central acting selective α2 agonist with minimal respiratory effects, is increasingly being used to facilitate awake fiberoptic intubation. Although the effect of increasing plasma concentrations of dexmedetomidine in adult humans has been described,8,9 at the time this case occurred the use of dexmedetomidine in a parturient had not been reported. Little is known about in vivo placental transfer of dexmedetomidine or about neonatal effects.

This case report describes the successful use of dexmedetomidine to facilitate awake fiberoptic intubation, with subsequent general anesthesia for cesarean delivery, in a parturient with spinal muscular atrophy type III.

Case report
A 35-year-old, 41-kg, 1.27-m, G4 P0 woman with SMA type III at 35+1 weeks presented for urgent cesarean section after premature spontaneous rupture of membranes. Past medical history was significant for anemia, asthma, thoracoscopic spinal fusion and severe restrictive lung disease. Vital signs were blood pressure 123/89 mmHg, heart rate 94 beats/min, respiration 12
breaths/min, temperature 37.4°C and oxygen saturation 100% on room air. On examination she had a Mallampati class 4 airway with mouth opening only 12 mm, limited cervical spine movement, complete airway obstruction with head turned to the left and severe scoliosis. Records of previous anesthetics were unavailable. Her pulmonary function and symptoms of airway obstruction had been progressively worsening since her previous surgery during adolescence.

During pregnancy she had been referred to anesthesiology, pulmonary medicine, orthopedic surgery, cardiology and dental surgery departments for presurgical evaluation. Her case was discussed at weekly multidisciplinary high risk obstetrical conferences and her treatment plan continually updated as her pregnancy progressed. She was directly involved with surgical planning and consented to awake airway management with dexmedetomidine while avoiding benzodiazepines and opioids before delivery. Postoperative intensive care unit admission was also anticipated.

She underwent thorough preoperative evaluation. Echocardiography indicated normal cardiac function and an ejection fraction of 70%. Spine radiographs showed convex right scoliosis with posterior surgical fusion extending from high thoracic to the sacrum (Fig. 1). Pulmonary function tests (PFT) were consistent with severe restrictive lung disease and severe decrease in diffusing capacity (Table 1). Room air arterial blood gas analysis was normal. Her hemoglobin was 11.7 g/dL.

In the operating room she was put in the right lateral position with her head turned to the right for maximal airway patency (Fig. 2). After initial positioning, standard monitors were applied and supplemental oxygen was administered. A radial arterial catheter was inserted under local anesthesia. Dexmedetomidine 1 µg/kg was administered i.v. over 10 min, followed by an infusion of 1 µg·kg⁻¹·h⁻¹. Topical 4% lidocaine was progressively administered to the oro pharynx and hypo pharynx. Midway through initial placement of the flexible fiberoptic intubating bronchoscope the patient became anxious, the scope was withdrawn, and a 0.5-µg/kg bolus of dexmedetomidine was administered. During the second intubation attempt the fiberoptic bronchoscope was introduced into the trachea, but upon threading the endotracheal tube the scope became dislodged resulting in esophageal placement, which was immediately recognized. The patient was successfully intubated on the third attempt using the flexible fiberoptic bronchoscope. Throughout the procedure the patient maintained an adequate respiratory depth and rate and oxygen saturation remained 100%. Dexmedetomidine was administered for a total of 1.84 µg/kg over 38 min, during which time vital signs were recorded every minute (Fig. 3). The patient was hypertensive before initiation of dexmedetomidine. During the time of fiberoptic intubation, systolic blood pressure ranged from 110 to 169 mmHg, diastolic blood pressure from 78 to 111 mmHg, and maternal heart rate from 109 to 130 beats/min. The patient became hypotensive after induction of general anesthesia. This was treated with two 5-mg doses of intravenous ephedrine. Intermittent fetal heart tones were normal and unchanged.

After the endotracheal tube was secured, dexmedetomidine was discontinued and general anesthesia was induced with sevoflurane and maintained by intermittent positive-pressure ventilation with 2% sevoflurane in oxygen. Due to anatomic irregularities and a lack of sufficient peripheral intravenous access, right internal jugular central venous catheter was placed under ultrasound guidance. The placement was complicated by

![Fig. 1 AP (A) and lateral (B) lumbar and lower thoracic spine at 34 weeks of gestation. Note the persistent scoliosis despite spinal surgery, and the fetal limbs.](image-url)
contractures and lack of mobility in her cervical spine. Her entire body had to be repositioned for central venous catheter placement. Positioning difficulties continued for the surgeons, requiring considerable time to maximize exposure of the lower abdomen. Due to these difficulties we administered rocuronium 0.5 mg/kg. No opioids were administered to the mother before delivery. The baby was delivered 4 min after skin incision, 68 min after discontinuation of the dexmedetomidine infusion. At the time of delivery the maternal central venous dex-

Table 1  Pulmonary function test results (liters)

<table>
<thead>
<tr>
<th></th>
<th>Reference</th>
<th>Observed</th>
<th>% of reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>FVC</td>
<td>2.63</td>
<td>0.66</td>
<td>25</td>
</tr>
<tr>
<td>FEV₁</td>
<td>2.39</td>
<td>0.56</td>
<td>24</td>
</tr>
<tr>
<td>FEF₂₅₋₇₅%</td>
<td>3.26</td>
<td>0.85</td>
<td>26</td>
</tr>
<tr>
<td>IC</td>
<td>1.73</td>
<td>0.61</td>
<td>35</td>
</tr>
<tr>
<td>DLCO</td>
<td>22.9</td>
<td>5.6</td>
<td>24</td>
</tr>
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FVC: force vital capacity; FEV₁: forced expiratory volume in one second; FEF₂₅₋₇₅%: Forced expiratory force during mid expiration; IC: inspiratory capacity; DLCO: carbon monoxide diffusion.

Fig. 2  The patient positioned on the operating table for surgery. The patient gave consent to publication.

Fig. 3  Vital signs during dexmedetomidine infusion.
medetomidine concentration was 710 pg/mL, umbilical arterial concentration 540 pg/mL and umbilical venous concentration 543 pg/mL (measured by Midwest Research Institute and paid for by Hospira). The Apgar score was 6 at 1 min and 8 at 5 min. Umbilical arterial blood gas analysis revealed a pH 7.35, PCO₂ 6.25 kPa (46.9 mmHg), PO₂ 3.87 kPa (29 mmHg). Umbilical venous blood gas analysis revealed a pH of 7.35, PCO₂ 6.08 kPa (45.6 mmHg), PO₂ 7.74 kPa (58.1 mmHg).

The neonate initially had an oxygen saturation of 88% and required assisted ventilation for 3 min, after which he was given supplemental oxygen and then room air. At 5 min of age his heart rate was 160 beats/min and oxygen saturation 95%. Neurobehavioral and physical examinations were normal at 15 min.

After delivery, uterine dermoid cyst removal, left salpingo-oophorectomy and right tubal ligation were performed. Throughout this period of the operation fentanyl 250 µg but no additional muscle relaxant was given. At the conclusion, 80 min after skin incision and 140 min after the muscle relaxant, facial nerve stimulation revealed a train of four ratio of 1. Neostigmine 2.5 mg and glycopyrrolate 0.5 mg were administered and general anesthesia was discontinued.

After regaining consciousness, the patient displayed marked residual weakness of the muscles of her upper extremities, head and neck. She remained intubated and ventilated and was taken to the surgical intensive care unit. Approximately 4 h later she was extubated and 6 h after extubation transferred to the high-risk maternity ward. Postoperatively she was asked about her intubation experience. She remembered feeling some anxiety during portions of the procedure and could recall specific phrases spoken by operating room personnel until general anesthesia was induced. However, due to the sedation of dexmedetomidine and extensive preoperative warning about what to expect, at no time did she feel frightened or overanxious. Instead, she expressed gratitude for the mental preparation she had received. She left the maternity ward one week postpartum with a healthy infant.

**Discussion**

This patient presented multiple challenges to the anesthetic team. Extensive spinal fusion from high thoracic to sacral vertebrae precluded central neuraxial blockade. Her limited mouth opening, restricted cervical spine movement and inability to breathe with her head turned to the left all suggested that intubation by direct laryngoscopy was unlikely to be possible.

Awake fiberoptic intubation is our preferred method for securing the airway in patients with anticipated difficult airway.10,11 The ASA difficult airway algorithm includes both awake intubation and awake tracheostomy as options when airway compromise indicates that induction of anesthesia before securing the airway may be unwise.12 Dexmedetomidine has been used to facilitate intubation in difficult airway situations by providing sedation without respiratory depression or compromise.13–17 As both opioids and benzodiazepines can cause significant maternal and fetal depression, dexmedetomidine was selected for its sedative properties and lack of respiratory suppression.

In previous case reports the total doses of dexmedetomidine needed for sedation for awake fiberoptic intubation were a bolus ranging from 0.5 to 1 µg/kg followed by infusion of 0.2 to 0.7 µg·kg⁻¹·h⁻¹,14–17 significantly less than the 1.5-µg/kg bolus and 1-µg·kg⁻¹·h⁻¹ infusion that was necessary in our patient. In a retrospective review of all the cases of awake fiberoptic intubation where dexmedetomidine was the primary sedative at our institution, the average total dose was 0.92 ± 0.4 µg/kg (n = 44, unpublished data). However, in the present case dexmedetomidine was used alone, whereas in most of the other cases it was not.15 Given the extent of airway compromise at baseline and the assessed difficulty of her airway, it was felt that, even though small doses of opioids might have blurred memory and decreased the overall dexmedetomidine dose, they were highly likely to lead to airway compromise.

The decision to administer muscle relaxants to this patient was made only after she was anesthetized, when it became clear that additional relaxation would be needed to facilitate surgical exposure. Thus our original plan, to avoid muscle relaxants with the goal of extubation at the end of the procedure, was abandoned. In this case, as in others, rocuronium would have contributed to her postoperative muscle weakness and the need for mechanical ventilation.2

After administration of a total of 1.84 µg/kg of dexmedetomidine over 38 min, followed by 68 min of general anesthesia needed for central catheter placement, surgical positioning and cesarean delivery, the umbilical artery concentration of dexmedetomidine was 540 pg/mL and the fetal/maternal (F/M) concentration ratio 0.76, indicating significant fetal exposure to dexmedetomidine. This value is consistent with the F/M ratio of 0.77 ± 0.06 found by Ala-Kokko et al. in isolated perfused human placentas.18 Similar umbilical arterial and venous levels indicate little net placental transfer after so long a time lapse. In this case dexmedetomidine did not result in fetal bradycardia and umbilical cord blood gas analysis was within normal limits. Fifteen minutes after delivery the neonatal neurobehavioral and physical status was normal. The lower Apgar scores (6 and 8) probably relate to gestational age at delivery and residual inhalational anesthetic. The presence of dexmedetomidine could have contributed to the low Apgar scores, but this seems unlikely given the rapid recovery of the neonate.
Although pharmacokinetic data cannot be determined, this case confirms existing in vitro data that dexmedetomidine has significant placental transfer. Nevertheless, serious neonatal effects were not detected. Moreover, dexmedetomidine used alone provided adequate sedation, without respiratory compromise, to facilitate awake fiberoptic intubation in this patient with spinal muscular atrophy type III, although larger than normal doses were needed.

References