Does Delivery Improve Maternal Condition in the Respiratory-Compromised Gravida?

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Objective: To describe the effect of delivery on respiratory status and outcome in the respiratory-compromised pregnant woman.

Methods: During 1990–1994, 10 patients requiring intubation for respiratory compromise who delivered during ventilatory support were identified by International Classification of Diseases, Ninth Revision codes. Charts were reviewed retrospectively for cardiorespiratory variables and outcome.

Results: Pneumonia led to intubation in all but one case. The onset of labor was spontaneous in eight. Three were delivered by cesarean. Mechanical ventilation was used for a median (range) of 7 (2–22) days in surviving patients. Fraction of inspired oxygen requirements decreased an average of 28% by 24 hours after delivery. Positive end-expiratory pressure requirements remained unaltered. Surviving patients remained intubated for a median (range) of 2.6 (1–19) days postpartum. Three women died, all after vaginal delivery (days 4–14).

Conclusion: Delivery of respiratory-compromised gravidas resulted in a 28% reduction in fraction of inspired oxygen requirement within 24 hours after delivery. Although most patients were then able to be maintained below critical fraction of inspired oxygen requirement levels (under 0.6), dramatic improvement in overall respiratory function was not observed uniformly. Given the limited benefit of delivery on maternal oxygenation, along with the inherent risks of labor induction in this critically ill population, caution should be exercised in initiating the induction process electively. (Obstet Gynecol 1998;91:108–11. © 1998 by The American College of Obstetricians and Gynecologists.)

Although delivery has been reported to improve maternal hemodynamics and outcome in acute cardiovascular collapse, little information exists regarding the benefits (or risks) of delivery in the respiratory-compromised gravida.1,2 Anecdotal experience suggests that evacuation of the uterus may improve ventilation.3 During normal pregnancy, respiratory rate and total lung volume are not altered, but tidal volume is significantly increased. There is a corresponding decrease in expiratory reserve and residual volumes. In the healthy gravida, these physiologic changes are well compensated.

However, it can be hypothesized that the distended uterus mechanically compromises the pregnant woman with respiratory failure. If an argument can be made for the theoretical advantages of the improved gas exchange following delivery, one might advocate empirically trying this approach, provided no disadvantage can be identified. Unfortunately, the maternal demands of labor and possible operative delivery cannot be ignored. Hyperventilation occurs in normal labor, partly as a response to pain. In addition, oxygen consumption increases significantly.4 Although proper analgesia will decrease hyperventilation, oxygen delivery may be inadequate to meet the overall increased demand in the respiratory-compromised gravida. Ackerman et al5 noted a decrease in maternal mixed venous oxygen saturation with each contraction in a woman laboring after intubation for adult respiratory distress syndrome (ARDS). These concerns are amplified with an elective induction and its potential for a long labor and increased risk of cesarean delivery. We here review our experience and present an observational case series of severely respiratory compromised pregnant patients, describing the effect of delivery on their respiratory status.

Materials and Methods
Pregnant women admitted to Hutzel Hospital in Detroit, Michigan, and requiring endotracheal intubation between January 1, 1990, and December 31, 1994, were identified from both the medical records database by
Table 1. Maternal Characteristics

<table>
<thead>
<tr>
<th>Patient</th>
<th>Age (y)</th>
<th>Gravidity/Parity</th>
<th>Gestational age at admission (wk)</th>
<th>Admission to intubation (d)</th>
<th>Intubation to delivery (h)</th>
<th>Mode of delivery</th>
<th>Delivery to extubation (d)</th>
<th>Total ventilator days</th>
<th>Total hospital days</th>
<th>Maternal outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20</td>
<td>3/0</td>
<td>34</td>
<td>1</td>
<td>17</td>
<td>Vaginal</td>
<td>2.3</td>
<td>3</td>
<td>7</td>
<td>Discharged</td>
</tr>
<tr>
<td>2</td>
<td>17</td>
<td>1/0</td>
<td>34</td>
<td>2</td>
<td>24</td>
<td>Vaginal</td>
<td>1</td>
<td>2</td>
<td>10</td>
<td>Discharged</td>
</tr>
<tr>
<td>3</td>
<td>31</td>
<td>5/3</td>
<td>31</td>
<td>1</td>
<td>45</td>
<td>Vaginal</td>
<td>4.1</td>
<td>6</td>
<td>7</td>
<td>Died</td>
</tr>
<tr>
<td>4</td>
<td>34</td>
<td>6/3</td>
<td>30</td>
<td>1</td>
<td>14</td>
<td>Vaginal</td>
<td>14.9</td>
<td>15.5</td>
<td>19</td>
<td>Discharged</td>
</tr>
<tr>
<td>5</td>
<td>20</td>
<td>1/0</td>
<td>32</td>
<td>3</td>
<td>10</td>
<td>Vaginal</td>
<td>2.6</td>
<td>3</td>
<td>10</td>
<td>Discharged</td>
</tr>
<tr>
<td>6</td>
<td>31</td>
<td>1/0</td>
<td>19</td>
<td>3</td>
<td>63</td>
<td>Vaginal</td>
<td>6.4</td>
<td>9</td>
<td>12</td>
<td>Died</td>
</tr>
<tr>
<td>7</td>
<td>12</td>
<td>1/0</td>
<td>23</td>
<td>0</td>
<td>324</td>
<td>Vaginal</td>
<td>13.5</td>
<td>32</td>
<td>32</td>
<td>Died</td>
</tr>
<tr>
<td>8</td>
<td>19</td>
<td>1/0</td>
<td>34</td>
<td>5</td>
<td>75</td>
<td>Cesarean</td>
<td>18.9</td>
<td>22</td>
<td>42</td>
<td>Discharged</td>
</tr>
<tr>
<td>9</td>
<td>30</td>
<td>6/4</td>
<td>37</td>
<td>0</td>
<td>126</td>
<td>Cesarean</td>
<td>1.8</td>
<td>7</td>
<td>18</td>
<td>Discharged</td>
</tr>
<tr>
<td>10</td>
<td>34</td>
<td>5/3</td>
<td>32</td>
<td>0</td>
<td>5</td>
<td>Cesarean</td>
<td>13.8</td>
<td>14</td>
<td>18</td>
<td>Discharged</td>
</tr>
<tr>
<td>Median</td>
<td>25</td>
<td>2/0</td>
<td>32</td>
<td>1</td>
<td>34.5</td>
<td></td>
<td>2.6*</td>
<td>7*</td>
<td>18*</td>
<td></td>
</tr>
</tbody>
</table>

* Surviving patients.

codes of the International Classification of Diseases, Ninth Revision and the Maternal Special Care Unit logbook. The medical records were screened to identify those patients who were intubated because of significant respiratory compromise and who delivered while on mechanical ventilation. Charts were reviewed for demographic data along with maternal and fetal outcomes. The date and time of intubation, delivery, and extubation were noted. The following serial antepartum and postpartum ventilator settings were examined: tidal volume, fraction of inspired oxygen, ventilator rate, and positive end-expiratory pressure. Plateau pressure and peak inspiratory pressure were recorded. Minute ventilation and static compliance were calculated. It is the practice in our unit to adjust the ventilator settings, primarily the fraction of inspired oxygen and positive-end-expiratory pressure, to maintain arterial oxygen tension (PaO₂) near 80 mmHg, but at least 60 mmHg. To prevent excess blood loss from frequent blood gas determinations, oxygen saturation was followed continuously as a surrogate marker. Oxygen saturations of 90% and 95% corresponded roughly to PaO₂ of 60 and 80 mmHg, respectively. Arterial blood gases were obtained when a change in the oxygen saturation was noted or when ventilator settings were changed. Oxygen saturation values are reported rather than PaO₂ because they were determined noninvasively and thus were recorded reliably at desired intervals. The use of blood transfusions or vasopressor agents also was noted.

The various ventilatory indices were examined approximately 6 hours before delivery, at delivery, and 12, 24, and 48 hours after delivery. Data are presented as median and range because of the small sample size and skewed distribution.

Results

Ten pregnant patients requiring mechanical ventilation who delivered subsequently while receiving ventilatory support were identified among the 42,670 deliveries occurring during the study period. Criteria for intubation were subjective and were based on the attending physician's concern for falling arterial oxygenation and patient exhaustion. Selected individual maternal characteristics are displayed in Table 1.

In nine patients, progressive respiratory insufficiency secondary to pneumonia led to intubation. Respiratory insufficiency with associated hypertensive crisis resulted in mechanical ventilation in the other case. Coexisting conditions included renal abscess, negative laparotomy for suspected appendicitis, asthma, and preterm labor with preeclampsia. Overall, seven of the ten women survived. One of the three maternal deaths was associated with insulin-dependent diabetes, recurrent hypoglycemia, gastroparesis, abdominal pain, nausea, and vomiting requiring total parenteral nutrition (Table 1; patient 6). Respiratory failure secondary to adult RDS was the cause of death in this patient. Another death was secondary to varicella pneumonia unresponsive to parenteral acyclovir (Table 1; patient 3). The final patient died of adult RDS after suspected viral pneumonia (Table 1; patient 7).

Ventilator indices before delivery and 24 hours postpartum are summarized in Table 2. Individual oxygen requirements over time are shown in Figure 1. Only two patients were extubated during the first 48 hours after delivery. Six received red blood cell transfusions. Vasopressor drugs were required before delivery in only one case (Table 1; patient 1). Dopamine was started at a low dose less than 4 hours before delivery, to maintain blood pressure. Increased dopamine doses and the
addition of dobutamine were required beginning at approximately 36 hours postpartum. The patient was weaned from these drugs over the next 48 hours.

Seven patients delivered vaginally, six of them following spontaneous onset of labor. Indications for the three cesarean deliveries included nonreassuring fetal heart rate tracing in early labor, malposition of a first twin in early labor, and failed induction initiated to "improve maternal status." The three maternal deaths followed vaginal delivery on postpartum days 4, 6, and 14.

There were 12 fetuses (two sets of twins). Eight were delivered after 30 weeks, including both sets of twins.

All of these neonates survived. One fetus was delivered after induction at 23 weeks' gestation because of deteriorating maternal condition; neither the mother nor the infant survived. The median (range) birth weight of the 11 infants born after 20 weeks was 1800 (780–2460) g, and all weights were appropriate for gestational age. The median (range) Apgar scores at 1 and 5 minutes were 3 (1–8) and 7 (1–9), respectively. The final patient aborted spontaneously at 19 weeks.

Discussion

Acute respiratory failure in the gravida presents a difficult challenge for the obstetrician and the critical care specialist. The condition is uncommon; Mabie and colleagues reported a prevalence of adult RDS of 0.03% of deliveries at their tertiary referral center. In addition, pregnancy gives rise to significant physiologic changes within the respiratory system. Fetal well-being and the consequences of maternal diagnostic and therapeutic interventions on the fetus also are important considerations. Ventilation with high pressures and high oxygen concentrations often are required to maintain adequate oxygenation. Barotrauma and oxygen toxicity can result. Despite advances in critical care, maternal morbidity and mortality remain high in this subset of critically ill gravidas.

Although specific information to guide management of respiratory failure in the gravida is limited, pregnancy does not change the overall therapeutic goal of maintaining oxygenation while treating the underlying cause. Maternal benefits (or risks) resulting from delivery are unknown. The patients included in our series had severe respiratory compromise, as evidenced by a median predelivery fraction of inspired oxygen and positive end-expiratory pressure of 0.65 and 10 cm H₂O, respectively, required to maintain a PaO₂ near 80 mmHg. After delivery, median fraction of inspired oxygen decreased by 28% and was then maintained at a level less than 0.60. This represents a common threshold above which prolonged exposure has been associated with pulmonary toxicity. The lower oxygen requirements are important because prolonged mechanical ventilation was often required postpartum. However, it is important to note that the improvement in maternal oxygenation after delivery does not automatically imply a cause and effect relationship. None of the other ventilation indices measured showed any appreciable improvement immediately after delivery. The natural history of the disease process regardless of delivery in all likelihood contributed positively to the observed clinical improvement. Similarly, there was no consistent trend for individual patients with regard to timing of
reductions in the fraction of inspired oxygen in association with delivery.

The place for delivery in the management of respiratory compromise in the pregnant patient remains controversial. Daily and colleagues reported a case of adult RDS that developed after appendectomy. Their patient went into spontaneous labor and delivered approximately 60 hours postoperatively. Delivery was followed by dramatic improvement in respiratory function and extubation within 24 hours. Although we noted an overall decrease in the oxygen requirement, no clear benefit was seen in any of the other ventilator settings for the study group. Only three of the ten patients showed dramatic improvement in all characteristics, but only one of these was extubated within 48 hours of delivery. The other two patients remained intubated for an additional 14 days.

Unlike Daily et al., other investigators have had similar reservations about the benefits of delivery in the respiratory-compromised gravid. Mabie and colleagues reported on 12 antepartum patients with adult RDS. Ten of these delivered while being treated for the condition, most within 24 hours of admission. Although the effects of delivery were not addressed directly, maternal mortality in this group was 58%. On the basis of their experience, delivery was not recommended routinely. In a trial of surfactant replacement in adult RDS, Haslam et al. treated two pregnant women. Again, the specifics of peripartum management were not described, but both patients were delivered by cesarean, and neither survived. In a review of their experience with critically ill obstetric patients, Collop and Sahn describe five patients ventilated mechanically antepartum or intrapartum, only one of whom improved enough after delivery to allow extubation within 48 hours.

Often, the difficult decision concerning the need for induction and its associated risks can be avoided because spontaneous labor is a frequent occurrence, regardless of gestational age. Madinger et al. reported incidences of preterm labor and delivery of 44% and 36%, respectively, in patients with pneumonia complicating pregnancy. All but one of our patients were delivered preterm, and eight of ten went into labor spontaneously. In addition, one of the two inductions was unsuccessful and resulted in cesarean delivery.

Our experience does not support a clear benefit of emptying the uterus in an attempt to improve maternal oxygenation. We did note a decrease in oxygen require-

References


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