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Kate Henchey

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USE OF HELIOX THERAPY TO RELIEVE ACUTE RESPIRATORY DISTRESS IN AN ADOLESCENT WITH CYSTIC FIBROSIS: A CASE REPORT

By Kate Henchey, RN, BSN. From Duke University Medical Center and School of Nursing, Durham, NC.

Cystic fibrosis, a chronic genetic disorder that affects the exocrine glands, results in the production of excessive, thick mucus that obstructs the gastrointestinal tract and the lungs. Cystic fibrosis affects approximately 1 in 3500 white children and 1 in 12000 nonwhite children every year. In the United States, the pulmonary complications of cystic fibrosis, including asthma, airway obstruction, bronchiolitis, mucus plugging, and pneumonia, are the most common cause of morbidity and mortality in children who have the disorder. 

Traditionally, therapy for pulmonary complications of cystic fibrosis includes broad-spectrum antibiotics to control infection, aggressive drug therapy to promote bronchodilatation and thin mucus, humidified air, routine postural drainage and chest percussion to aid in clearing secretions, and oxygen for hypoxemia. Occasionally, despite these therapies, the airways can become so clogged with mucus that acute respiratory distress ensues, and alternative measures must be used to prevent respiratory failure. One new therapeutic measure is the use of heliox, a mixture of helium and oxygen delivered via a face mask. Heliox has been used and studied in adults with asthma, bronchitis, chronic obstructive pulmonary disease, and respiratory acidosis. A small amount of research has also been done in infants with bronchiolitis. Heliox is thought to be beneficial in these obstructive diseases because its low density results in a decrease in resistive forces, which improves delivery of oxygen to the distal airways. In this article, I describe the use of heliox in an adolescent with cystic fibrosis.

Case Report

A 15-year-old girl with a history of cystic fibrosis was admitted to the pediatric transitional care unit in acute distress. Her condition had previously been stable. Her last admission, 18 months before this event, was for a routine cystic fibrosis “tune-up.” The results of blood gas analysis of a sample of venous blood obtained from a central catheter while she was receiving 100% oxygen via a face mask were as follows: partial pressure of oxygen, venous, 38 mm Hg; partial pressure of carbon dioxide, venous, 32 mm Hg; pH 7.42; and bicarbonate 32 mmol/L. Respirations were 60/min to 70/min, with use of accessory muscles. Oxygen saturation as measured by pulse oximetry was 88% while she was receiving 100% oxygen via a face mask. Results of pulmonary function tests indicated that forced vital capacity and forced expiratory volume in 1 second were 19% and 16%, respectively, of predicted values. The ratio of residual volume to total lung capacity was 85% of the predicted value. A
chest radiograph revealed hyperinflation and the typical, chronic pulmonary changes associated with cystic fibrosis. A sputum culture confirmed antibiotic-resistant *Pseudomonas* and *Staphylococcus*.

Therapy was begun with administration of aerosolized bronchodilators, intravenous antibiotics and corticosteroids, and aggressive chest percussion. After several hours of therapy, no clinical improvement had occurred. Oxygen saturation had decreased to 85%, and respirations were still 60/min to 70/min. Heliox therapy via face mask was started 5 hours after admission; the initial percentages were 50% oxygen and 50% helium (Table 1). The patient was also given supplemental oxygen via a nasal cannula at a rate of 4 L/min. Within 5 minutes, oxygen saturation increased to 95% and respirations decreased to 40/min to 50/min. A repeat venous blood gas analysis indicated that the partial pressure of venous oxygen had not changed. The supplemental oxygen was rapidly discontinued. Within 2½ hours of initiation of heliox therapy, the mixture was changed to 70% helium and 30% oxygen, and within 5½ hours of initial therapy, supplemental oxygen via nasal cannula was discontinued. Heliox therapy was discontinued approximately 14 hours after its initiation, and the patient was maintained on 50% oxygen via a face mask. Subsequent pulmonary functions tests during the rest of her admission showed improvements in the ratio of forced vital capacity to forced expiratory volume in 1 second and a decrease in the ratio of residual volume to total lung capacity.

**Conclusion**

In conclusion, this patient responded well to heliox therapy. Hypoxemia was reversed, and gas exchange improved, thus reducing work of breathing and preventing retention of carbon dioxide. The acute respiratory distress was resolved, and traditional therapies such as chest percussion, antibiotics, and exercise were continued to return her to her previous baseline pulmonary function (Table 2).

**ACKNOWLEDGMENTS**

I thank Larry Simpson, RRT, for his assistance in collecting data on this patient’s response to heliox therapy.

**REFERENCES**


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**Table 2 Results of pulmonary function tests**

<table>
<thead>
<tr>
<th>Day of hospitalization</th>
<th>Forced vital capacity</th>
<th>Forced expiratory volume in 1 second to forced vital capacity</th>
<th>Total gas volume</th>
<th>Residual volume</th>
<th>Total lung capacity</th>
<th>Ratio of residual volume to total lung capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (admission)</td>
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<td>16</td>
<td>82</td>
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<td>Discharge</td>
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<td>35</td>
<td>70</td>
<td>144</td>
<td>223</td>
<td>90</td>
</tr>
</tbody>
</table>

*All values are percentages of predicted values.

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In this patient, heliox therapy quickly reversed hypoxemia and improved gas exchange.

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*Heliox therapy decreases resistive forces and thus improves oxygen delivery to distal airways.*