Heliox and ventilatory support: What does it mean for the future of infant care?

Helium-oxygen gas mixtures, commonly known as ‘Heliox’, show promise as a future therapy in a wide range of paediatric respiratory diseases. However, use of Heliox ventilation is not yet widespread in infant care. This article outlines principles and provides guidelines for Heliox-driven mechanical ventilation in neonatology and paediatrics.

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Key points

1. Heliox is a safe treatment.
2. Heliox, as an adjunct, may enhance mechanical ventilation in infants.
3. Conventional weaning strategies need to be reconsidered in the context of Heliox ventilation.
4. The success or failure of Heliox therapy relies heavily on optimising nursing care.
5. Increasing the helium content of the driving gas mixture is the key to maximising the benefits of Heliox.

In the year 2000, respiratory disease cost the National Health Service over £2.5 billion. Compared to adults, children are more likely to suffer from respiratory illnesses (TABLE 1). Mortality is highest in infancy amongst all paediatric age groups (FIGURE 1), with respiratory disease being one of the top three causes3,4. In the UK in 2004, 3,607 infants died, i.e. >1 in 200 infants5,6. It is clear therefore that new and more effective therapies need to be developed to address the growing burden of respiratory disease in infancy.

Administration of a helium-oxygen gas mixture (commonly termed ‘Heliox’) is one such therapy that has been tried in a wide range of paediatric and neonatal respiratory diseases (TABLE 2), with promising results. There have been no documented side effects in the past 35 years of paediatric use.

However, knowledge and awareness of this treatment option is still not widespread, particularly amongst paediatric and neonatal intensive care units, where it may become a life-saving treatment if the current trend of evidence continues. In this article the background principles behind Heliox therapy in intensive care units are reviewed and the use of Heliox-driven mechanical ventilation is discussed, including a proposed guidance for medical management.

Heliox and its effects on respiratory pathology
Heliox is any gas mixture containing helium (He) and oxygen (O2). In the UK this is available as a set preparation: Heliox-21, containing 21% O2 and 79% He. Therefore, in terms of oxygen content, it is comparable to air, which contains 21%.
O₂ and 79% nitrogen. However, due to the helium content, Heliox has a number of important properties (TABLE 3).

### Viscosity
Heliox has a high kinematic viscosity (ratio of viscosity to density). This promotes laminar flow, which makes it easier to breathe (FIGURE 2). The greater the helium content in the helium-oxygen gas mixture, the greater is the potential benefit. Heliox also passes through narrow airways more easily and may reduce the work of breathing by improving O₂ delivery to, and CO₂ removal from, the alveoli. Heliox may also reduce gas trapping and dynamic hyperinflation in obstructive lung disease.

### Diffusion of carbon dioxide and oxygen
Heliox has high binary diffusion coefficients for carbon dioxide and oxygen. This means that, in the presence of Heliox breathing, CO₂ and O₂ diffuse at a much more rapid rate which is important for alveolar gas transfer, i.e. Heliox may improve arterial oxygenation and removal of waste gases. Collateral ventilation at the bronchoalveolar level (through Martin’s Channels, Canals of Lambert and Pores of Kohn) is dependent on diffusion. Heliox may therefore enhance collateral ventilation and reduce atelectasis.

The effects of Heliox on cardio-respiratory physiology have been a source of debate for over 70 years. The effects noted in previous studies are summarised in TABLE 4. Most of the evidence is Grade 4 or 5. Further high quality physiological studies are therefore needed.

### A review of Heliox-driven mechanical ventilation
Heliox-driven mechanical ventilation is not new in paediatrics and neonatology. In 1991 Sauder et al. reported the successful use of Heliox ventilation to treat respiratory failure in a two month old infant who had Tetralogy of Fallot, pulmonary atresia and severe tracheal stenosis. This patient had hypercapnoeic respiratory failure unresponsive to high pressures and 100% oxygen with conventional ventilation. Subsequent introduction of Heliox ventilation allowed a gradual reduction in oxygen requirements from 100% down to 30%, a rise in SpO₂ from 80% to 96%, a rise in tidal volume from 66mL to 100mL and an improvement in acid-base with PaCO₂ dropping from 115mmHg to 29mmHg and pH improving from 7.03 to 7.55.

Elleau et al. provided favourable evidence for the use of Heliox ventilation in neonatal respiratory distress syndrome (RDS), demonstrating a combined reduction in incidence of morbidity (bronchopulmonary dysplasia) and mortality from 71% down to 23%, a reduction in oxygen requirements, a reduction in mean airway pressures and shorter duration of ventilation. This was the first well designed, prospective, double-blind randomised controlled trial of Heliox ventilation in neonates. Elleau’s work is supported by the earlier findings of Wolfson et al. who showed that spontaneously breathing infants with bronchopulmonary dysplasia had a significantly decreased pulmonary resistance, resistive work of breathing and mechanical power of breathing when breathing Heliox compared to air.

Most authors who have reported a benefit from Heliox ventilation have noted the effect after at least one hour of ventilation. Gross et al. presented a small case series of Heliox ventilation in infants with bronchiolitis but failed to show any statistically significant benefit from Heliox treatment. The authors of this study altered the helium-oxygen composition every 15 minutes. This may not have given sufficient time to equilibrate the ventilator driving gases nor for the benefits of the helium to be manifest. Furthermore, the sample size of only 10 patients is likely to have been too small to detect any statistically meaningful differences. Finally, a number of studies have demonstrated that the Servo 900C (amongst other ventilators) malfunctions with respect to tidal volume measurements and FI O₂ delivery, in the presence of helium-oxygen gas mixtures. Five out of the 10 patients in the Gross study were under three months of age. Accurately guiding such small tidal volumes and FI O₂ during volume-controlled Heliox ventilation is even more technically difficult, especially when the helium content is being altered every 15 minutes (with resultant changes in

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**TABLE 3** The physical properties of different gas mixtures.

<table>
<thead>
<tr>
<th>Gas</th>
<th>Approximate proportions in gas mixture</th>
<th>Density (ρ) (g/L)</th>
<th>Viscosity (η) (micropoises)</th>
<th>Diffusion co-efficient (cm²/sec)</th>
<th>Thermal conductivity (μcal.cm.sec.°K)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Oxygen</td>
<td>Nitrogen</td>
<td>Helium</td>
<td></td>
<td>CO₂</td>
</tr>
<tr>
<td>Air (‘Nitrox-21’)</td>
<td>21%</td>
<td>79%</td>
<td>0%</td>
<td>1.29</td>
<td>170.8</td>
</tr>
<tr>
<td>Heliox-21</td>
<td>21%</td>
<td>0%</td>
<td>79%</td>
<td>0.43</td>
<td>189.5</td>
</tr>
<tr>
<td>Oxygen</td>
<td>100%</td>
<td>0%</td>
<td>0%</td>
<td>1.43</td>
<td>192.6</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>0%</td>
<td>100%</td>
<td>0%</td>
<td>1.25</td>
<td>167.4</td>
</tr>
<tr>
<td>Helium</td>
<td>0%</td>
<td>0%</td>
<td>100%</td>
<td>0.18</td>
<td>188.7</td>
</tr>
</tbody>
</table>

**TABLE 4** The cardiorespiratory effects of Heliox.

**Impact of breathing Heliox on physiology**

**Cardiovascular effects**
- Increased cardiac index
- Decreased right atrial pressure
- Increased pulse pressure
- Decreased pulse pressure variations
- No change in heart rate
- Increased pulmonary blood flow

**Respiratory effects**
- Reduced work of breathing
- Reduced peak and mean airway pressures
- Reduced intrinsic PEEP
- Improved oxygenation
- Improved carbon dioxide clearance
- Reduced gas trapping and dynamic hyperinflation
- Reduced atelectasis
- Reduced inflammatory cell infiltration

**FIGURE 2** The effect of Heliox on gas flow pattern in the airway.

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gas mixture density, flow and ventilator function).

In contrast, Brown et al. reported the effective use of Heliox-driven mechanical ventilation in a case of respiratory insufficiency due to bronchiolitis, with a dramatic reduction in CO₂ and acid-base balance, immediately after switching from conventional air/oxygen to Heliox-driven ventilation. Nonetheless, it is interesting to note that, despite the short time intervals of their study, Gross et al. reported a significant reduction in intrapulmonary shunting with Heliox ventilation – similar to the findings of Schaeffer et al.

Abd-Allah et al. showed that Heliox ventilation could reduce peak inspiratory pressures significantly whilst simultaneously achieving improvements in arterial pH and CO₂ clearance, consistent with the findings of several case series of Heliox ventilation involving children.

Much of the above evidence for Heliox ventilation was derived while using existing ventilators. Conventional ventilators are inaccurate in the presence of Heliox, making patient management difficult. We therefore recommend that Heliox-calibrated ventilators should, preferably, be used for this purpose. There are only two such ventilators currently available in the UK (Inspiration LS, eVent Medical and AVEA, Viasys Healthcare) (FIGURES 3 & 4).

It is clear from the above evidence that Heliox shows promise for the advancement of respiratory intensive care. However, to date, no guidelines exist for its use. Therefore, outlined below is a set of principles to guide Heliox ventilation in paediatrics and neonatology, based on the literature evidence to date and the collective experience of Heliox ventilation from a number of institutions across Europe and North America. As more evidence comes to light, these guidance notes will, no doubt, need to be reviewed and updated.

Nursing and practical considerations
Providing Heliox therapy to an infant has proven to be a nursing challenge in several ways. Heliox therapy is a relatively new concept in nursing practice, therefore nurse educators will have a key role to play. Administering Heliox requires a good understanding of the properties of this gas and how it works. With oxygen therapy the instinctive practice is to increase the oxygen flow or FiO₂ as the patient becomes more hypoxic. In contrast, with Heliox therapy one has to ‘balance’ the helium and oxygen delivery. Indeed, instead of increasing the percentage of oxygen being administered, it is extremely important in Heliox therapy to maximise, when possible, the percentage of helium being given which will make it easier for the oxygen to be ‘carried’ down with the helium to the different levels of the lung. Therefore, the ultimate objective is to use the minimum amount of oxygen required to maintain the patient’s oxygen saturations at a satisfactory level. Experience has shown that this is perhaps the most difficult concept to understand and the greatest change to current nursing practice.

The setup shown in FIGURE 5 is, in the authors’ opinion, the optimum circuit design for driving mechanical ventilation using helium-oxygen gas mixtures. Each component is selected for its particular Heliox-compatibility features. Furthermore, it should be noted that the system shown in FIGURE 5 is not just suitable for Heliox ventilation but may be used equally well for conventional mechanical ventilation using air-oxygen gas mixtures.

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**FIGURE 3** Inspiration ventilator from eVent Medical.

**FIGURE 4** AVEA ventilator from Viasys.

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**FIGURE 5** Recommended setup for optimum delivery of helium-oxygen mechanical ventilation.
supine or prone position unless there is regional collapse of the lung necessitating ‘turning’ of the baby (FIGURE 6).

Humidification

Davies et al. have demonstrated that gases cool rapidly between the point of release from the humidification chamber to the point of entry into the airway. This effect may be greater in the presence of Heliox. It is therefore important that helium-oxygen gas mixtures are well heated and humidified as helium can theoretically carry heat away from surfaces more readily, predisposing to cooling of the patient. This is especially important for neonates and infants. However, as long as the gases are heated and humidified to at least 37°C at the point of entry into the airway, this concern should be satisfactorily addressed.

Ventilating simultaneously with Heliox and anaesthetic gases

Although compatibility of Heliox and volatile anaesthetic gases may be possible, there is currently no ventilator that can technically administer both. It is therefore not recommended that Heliox ventilation be utilised if volatile anaesthetic gases need to be used (e.g. intra-operatively).

Condensation in the expiratory limbs of Heliox ventilation circuits

During conventional ventilation the expiratory limb of the ventilation circuit does not contain any heating coil or insulation to avert cooling of expiratory gases. With Heliox ventilation there may be considerable condensate in the expiratory tubing which may potentially affect gas calibrations and ventilator function. Thus the use of insulated and heated expiratory tubing for the ventilation circuit is recommended during Heliox-driven ventilation as well as heating and humidifying the inspired gases.

Calibration of flow sensors and capnographs

Bernoulli’s principle states that gas flow in a tube is affected by the density of the gas in that tube. Therefore flow sensors and capnographs are liable to be inaccurate unless specifically calibrated for use with low density helium-oxygen gas mixtures.

Importance of monitoring

Monitoring inspired fractions of oxygen (FiO2) is as important as helium (FiHe) during Heliox ventilation. Ideally, one should have an FiHe display as well as FiO2 to help guide therapy. Vater et al. showed that there was some benefit in flow characteristics at all levels of FiHe but that the benefit increases with increasing FiHe, with the maximal rise in benefit noted at an FiHe of between 0.4 and 0.6, which is also consistent with the authors’ experience.

Preservation of ventilation circuit integrity

It is important to address this for two reasons. Heliox is relatively more expensive than oxygen and loss of the gas would make the treatment less cost-effective. Furthermore, leakage of the gas could preferentially cause loss of helium from the respiratory tract, thereby diminishing any potential benefit of Heliox. Thus it is important not to ‘break’ the ventilation circuit during Heliox ventilation. If tracheal toilet is required in-line suction catheters should be used. Nebulisation, if required, may be administered by using an in-line piezoelectric nebuliser (note: some piezoelectric nebulisers cannot nebulise steroids). The same ‘in-line’ concepts also apply to inhaled nitric oxide administration.

Principles of Heliox-driven respiratory support

Heliox-driven respiratory support should be considered in the following cases:

- Patients who have obstructive airways disease, both upper and lower (e.g. respiratory distress syndrome, asthma, bronchiolitis, croup).
- Patients who have lung atelectasis (e.g. pneumonia, acute lung injury).
- Patients with narrow endotracheal tubes, who may also benefit.

Mode of mechanical ventilation

The bulk of evidence for Heliox-assisted therapy is in the areas of CMV and SIMV modes of ventilation. As there is less evidence for the other modes of conventional mechanical ventilation, the use of only ‘CMV’ and ‘SIMV’ is recommended until further evidence becomes available for Heliox ventilation. The ventilators approved for Heliox delivery, that are currently available in the UK, have certain limitations. It is not possible, with current technology, to accurately control tidal volumes of less than 40mL. In such patients, therefore, therapy is directed by pressure-mode and not by volume-mode. A further limitation is that in patients under 0.5kg weight, the tidal volumes become too small to be regulated by Heliox ventilators in either mode.

The mode of ventilation to be used will, therefore, be determined by the desired tidal volume (Vt) which will, in turn, be limited by the weight of the patient. Heliox-driven volume-controlled ventilation is currently not recommended in patients needing Vt < 40mL (i.e. approximately < 6kg). Heliox-driven pressure-controlled ventilation may be used in patients down to premature neonates with ETT size 2.0mm internal diameter and a weight of at least 500 grams and above.

As previously stated it is important to maximise the helium content to gain the greatest potential benefit of Heliox mechanical ventilation. This means that FiO2

![FIGURE 6 A patient on Heliox ventilation.](image)

**TABLE 5** Selecting the most appropriate mode for Heliox-driven mechanical ventilation.
should be kept to the minimum required for adequate oxygenation, in order to optimise FiHe. This necessitates greater flexibility and tolerance of oxygen saturations. The aim is to achieve FiHe ≥ 0.6, i.e. FiO₂ ≤ 0.4 where possible. If a patient is hypoxic, it is preferable to use volume recruitment strategies; increase PEEP, VT (or PIP in the case of pressure-controlled ventilation) before increasing FiO₂.

**Special features of Heliox respiratory support**

**Success requires patience** - When increasing Heliox ventilation settings (PIP, VT or PEEP), wait at least 15-30 minutes before increasing further, as Heliox-driven lung recruitment may take time. Resist the urge to increase FiO₂ during this time period. Accept SpO₂ as low as 90%.

**Effect on VT and PIP** - In volume-controlled ventilation, the higher the FiHe then the lower will be the PIP generated, whilst still achieving the same VT. In pressure-controlled ventilation, the higher the FiHe then the higher will be the VT generated, whilst still achieving the same PIP. However, alveolar recruitment may take time (up to one hour) to become fully manifest.

**Effect on PEEP** - In terms of volume recruitment (VT) it has been suggested that 1-2 cmH₂O PEEP generated by Heliox may be equivalent to up to 5 cmH₂O PEEP generated by air/oxygen mixtures. Therefore when weaning from mechanical ventilation, it is recommended that the PEEP is reduced down to at least 2 cmH₂O before extubation.

Increasing PEEP may lead to gas trapping in conventional ventilation. However, this is less likely with Heliox ventilation as the physical properties of the gas reduce the likelihood of gas trapping. Thus increases in Heliox-PEEP should lead to an increase in alveolar recruitment up to a higher “maximum” PEEP before gas trapping starts to become a problem. This indicates Heliox may confer advantage compared to conventional gases when using PEEP levels up to 9 cmH₂O.

**TABLE 6** Recommended initial settings for Heliox ventilation.

<table>
<thead>
<tr>
<th>Parameter to wean</th>
<th>Target</th>
<th>Wean only if all the following conditions are met</th>
<th>Weaning strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. FiO₂ ≤ 0.4</td>
<td>• SpO₂ &gt; 90% • Patient has been on the current settings for at least 10 consecutive minutes</td>
<td>Reduce FiO₂ in steps of 0.05 1. Wait at least 10 minutes between each drop in FiO₂, before weaning further 2. If at any point after a drop in FiO₂, the SpO₂ &lt; 90% for 5 mins go back up on the FiO₂ by 0.05</td>
<td></td>
</tr>
<tr>
<td>2. PIP 16 cmH₂O</td>
<td>Stable for at least the past 2 hours on the following settings: • Set PIP &gt; 16 cmH₂O AND • FiO₂ ≤ 0.4</td>
<td>Reduce the “set PIP” in steps of 1 cmH₂O (note that even one cmH₂O PIP of Heliox is a lot!!) 1. Wait at least 2 hours between each drop in PIP 2. If at any point within this waiting period, the SpO₂ &lt; 90% for 5 consecutive minutes go back up on the PIP by +1 cmH₂O. DO NOT increase FiO₂ during this waiting period</td>
<td></td>
</tr>
<tr>
<td>3. PEEP 2 cmH₂O</td>
<td>Patient has been on the current settings for at least 2 hours • SpO₂ &gt; 90% • FiO₂ ≤ 0.4</td>
<td>Reduce the PEEP in steps of 1 cmH₂O until you reach the target of 2 cmH₂O 1. Wait at least 2 hours between each drop in PEEP 2. If at any point within this waiting period, the SpO₂ &lt; 90% for 5 consecutive minutes increase PEEP by 1 cmH₂O</td>
<td></td>
</tr>
<tr>
<td>4. RR 5 bpm</td>
<td>For at least the past 2 hours: • Patient is breathing (i.e. no longer paralysed) • There is adequate depth of spontaneous respiration • Backup respiratory rate (RR) &gt; 5 breaths per minute • PEEP ≤ 5 cmH₂O • Set PIP ≤ 16 cmH₂O • FiO₂ ≤ 0.4</td>
<td>Reduce the backup respiratory rate in steps of 5-10 breaths per minute (bpm). If the PaCO₂ is low, the respiratory rate can be weaned more aggressively. 1. Wait at least 2 hours between each drop in backup RR 2. If at any point within this waiting period, the SpO₂ &lt; 90% for 5 consecutive minutes go back up on the backup respiratory rate by 5-10 bpm</td>
<td></td>
</tr>
</tbody>
</table>

**TABLE 7** Weaning patients < 6kg in weight from Heliox ventilation.
Stepping down – It is suggested that patients be weaned directly from Heliox-driven mechanical ventilation onto either non-invasive Heliox-driven CPAP or, if tolerated, spontaneous inhalation of Heliox. This is because stepping down from Heliox-driven mechanical ventilation into conventional gases would mean simultaneously losing the ongoing benefits of Heliox as well as those of mechanical ventilatory support, thereby risking failure of weaning. Even changing from Heliox ventilation to conventional ventilation could result in a step back for the patient as there is such a significant difference between the two in terms of alveolar recruitment, as demonstrated by Nawab et al.

Drop in SpO2 – As the FiHe increases (and FiO2 drops), there may be a transient (10-15 minute) drop in SpO2 (occasionally as low as 85-90%) and a fall in PIP. This may be because it takes time for the higher FiHe to take effect (by increasing alveolar recruitment and oxygen delivery). The drop in SpO2 is followed by a subsequent rise in SpO2 and Vr if Heliox ventilation is successful.

Hypocapnoea – Be vigilant for hypocapnoea during Heliox ventilation. Heliox acts quite rapidly, particularly with gas mixtures that have higher helium content. This is because oxygen and CO2 gas transfers occur 3.5 times faster in the presence of Heliox than with conventional air/oxygen gas mixtures as explained earlier.

Guidance for the medical management of Heliox-driven mechanical ventilation

The following guide is proposed for starting, maintaining and weaning mechanical ventilation driven by helium-oxygen gas mixtures. This is because oxygen and CO2 gas transfers occur 3.5 times faster in the presence of Heliox than with conventional air/oxygen gas mixtures as explained earlier.

**Initial settings**

Settings for starting Heliox ventilation are shown in **TABLE 6**. Note that as a driving gas, Heliox has less distending pressure and effect on the alveoli than air/oxygen mixtures. Thus a longer inspiratory phase is required compared to conventional mechanical ventilation.

**Maintaining Heliox ventilation**

Aim to reach the following target parameters prior to discontinuing Heliox-driven mechanical ventilation:

- SpO2 ≥ 90%
- FiO2 ≤ 0.4
- PIP = 16 cmH₂O
- Respiratory rate = five breaths per minute

**Reducing Heliox ventilation settings**

Reduce the ventilation support if there is:

- Adequate CO2 clearance
- Adequate oxygenation
- There is no hypercapnoea or hypoxia

Consider discontinuing mechanical ventilation if patients meet the following criteria (**TABLE 7 & 8**):

- SpO2 ≥ 95% consistently for 10 minutes, reduce FiO2 further in 0.05 steps. Wait 10 minutes between each FiO2 change. If during this 10 minute period SpO2 < 90% for at least 5 minutes...go back up by 0.05 FiO2 step.

**TABLE 8** Weaning patients ≥6kg in weight from Heliox ventilation.
Management of hypercapnoea

Hypercapnoea, in the context of Heliox ventilation, is defined as:
- $\text{PaCO}_2 > 6 \text{kPa}$ (and showing a rising trend) for all paediatric/neonatal cases (except infants with chronic lung disease)
- $\text{PaCO}_2 > 2 \text{kPa}$ above their baseline (and showing a rising trend) for infants with chronic lung disease

In patients $< 6 \text{kg}$ weight ensure optimal lung recruitment using Heliox-PEEP strategies as described above. Once adequate Heliox-PEEP has been achieved, follow a sequence of increasing RR, followed by PIP (once maximum RR has been reached).

Management of hypoxia

Poor oxygenation that requires intervention, in the context of Heliox ventilation, is defined as:
- $\text{SpO}_2 < 90\%$ (and/or $\text{PaO}_2 < 8 \text{kPa}$) AND
- $\text{FiO}_2 > 0.4$

Use lung recruitment strategies before increasing $\text{FiO}_2 > 0.4$. Ensure optimal lung recruitment using Heliox-PEEP strategies as described above. Once adequate Heliox-PEEP has been achieved, follow a sequence of increasing PIP (or $V_t$), followed by RR (once maximum PIP or $V_t$ has been reached).

Recommended maximum settings

The recommended maximum settings for each of the ventilation parameters are:
1. Maximum PEEP = $9 \text{cmH}_2\text{O}$
2. Maximum RR = 40 breaths per minute (for infants) or 30 breaths per minute (children)
3. Maximum PIP = $30 \text{cmH}_2\text{O}$ for infants, $40 \text{cmH}_2\text{O}$ for children
4. Maximum $V_t$ = $10 \text{mL/kg}$

If all the above maximum recommended settings have been reached, increase $\text{FiO}_2$ as required in 0.05 steps. Once $\text{FiO}_2$ = 0.6 has been reached, if $\text{SpO}_2$ is still $< 90\%$ ($\text{PaO}_2 < 8 \text{kPa}$), start considering alternative modes of respiratory support in addition to Heliox. In the meantime, $\text{FiO}_2$ can still be increased up to a maximum of 0.9.

CONCLUSIONS

The special physical properties of Heliox have been utilised in the management of obstructive pulmonary disease conditions. These same properties also hold promise when Heliox is used as the driving gas in mechanical ventilation where lung protective and optimal recruitment strategies are employed. Improved $\text{CO}_2$ clearance in obstructive pulmonary disease states is the principle advantage of Heliox ventilation. Optimising the heliox content of the driving gas mixtures is the key to maximising the benefits of Heliox ventilation. Conventional weaning strategies must, therefore, be reconsidered in the context of Heliox ventilation.

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References