**HIGH FREQUENCY OSCILLATORY VENTILATION (HFOV)**

**Supporting information**

What are the indications for the use of HFOV in term and in preterm infants?

Infants with respiratory distress syndrome, whether term or preterm, need mechanical ventilation (Greenough, 1999). Conventional ventilation may cause lung injury, and this has been demonstrably reduced, in animal experiments, by the use of HFOV (Delemos, 1987). These results have not, however, been replicated in human studies (Soll, 2006), or confirmed by a Cochrane review and meta-analysis of two RCTs in a total of 199 infants (Henderson-Smart, 2009).

A randomised trial in 585 infants treated with either HFOV or conventional ventilation (Marlow, 2006) found that the mode of ventilation had no effect on respiratory or neurological outcomes at 2-year follow-up.

A small case series of 18 neonates of from 26-41 weeks gestation (Vierzig, 1994) identified those with a gestational age of at least 35 weeks and persistent pulmonary hypertension complicating pulmonary disease as being most likely to respond to HFOV (n=4 [22%]). A prospective clinical study in 20 patients (Ben Jaballah, 2006) found that HFOV improved gas exchange in a rapid and sustained fashion: after 1 hour, PaCO₂ had significantly decreased (p = .002) and remained in the target range thereafter. Target ventilation was achieved in all patients.

HFOV has also been used in rescue strategies following the failure of conventional ventilation (Clark, 1994; Kohelet, 1988) and in air leak syndromes such as pneumothorax and pulmonary interstitial emphysema (Clark, 1986).


Clark RH, Yoder BA, Sell MS. Prospective, randomized comparison of high-frequency oscillation and conventional ventilation in candidates for extracorporeal membrane oxygenation. J Pediatr 1994;124:447-54


**Evidence Level: IV**

**Should HFOV be used as a first line treatment or as rescue treatment?**

A Cochrane Review (Bhuta, 2001) found no randomised controlled trial data to support the routine use of rescue HFOV in term or near term infants with severe pulmonary disease, and called urgently for more research on this topic. Only 1 trial (involving 81 infants) was identified.

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in the review (Clark, 1994) and this found HFOV to be “a safe and effective rescue technique in the treatment of neonates with respiratory failure in whom conventional ventilation fails”. There were, however, no significant differences in the number of patients needing extracorporeal membrane oxygenation (RR 2.05, 95% CI 0.85-4.92), or in days on a ventilator, in oxygen or in hospital. Neither was there any evidence of a reduction in mortality at 28 days (RR 0.51, 95% CI 0.05-5.43).

Another Cochrane Review by the same team (Bhuta, 1998) found a similar lack of evidence in preterm infants and recommended that “any future use of HFOV as rescue therapy for preterm infants with severe RDS should be within randomized controlled trials and address important outcomes such as longer term pulmonary and neurological function”. A “BestBETS” report (Shah, 2003) concluded that “HFOV is probably not superior to conventional ventilation as primary mode of ventilation in preterm infants with respiratory distress syndrome for prevention of chronic lung disease or mortality at 36 weeks. However, use of HFOV is safe and not associated with increased risk of intraventricular haemorrhage or airleaks”.

This report included data from two multicentre, randomised trials in 500 infants (Courtney, 2002) and 400 infants (Johnson, 2002) respectively that appeared after the most recent Cochrane update.

A prospective study in 77 infants (Ben Jaballah, 2006) found that HFOV as an early rescue intervention resulted in rapid and sustained decreases in mean airway pressure, F IO(2), OI, and P AO(2) – Pa O(2) (P <= 0.01). The authors also identified a need for RCTs to confirm the perceived benefits of HFOV vs conventional ventilation.

**Evidence Level: I (For “No evidence”)**

**What should the starting settings be when commencing HFOV?**

Although frequencies between 3-50 Hz may be used during HFOV, 7-15 Hz “is most commonly employed” (Greenough, 1999). 10-20 Hz is also mentioned frequently as producing the best results (Chan, 1993; Hoskyns, 1991; Froese, 1987). New Zealand guidelines (Battin, 2001) recommend 10 Hz as an appropriate starting frequency.


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**Evidence Level: V**

**Should a high volume strategy be used?**
A Cochrane Review (Henderson-Smart, 2003) included a subgroup of 3 trials in which a high volume strategy was used. In this subgroup, there was a significant reduction in the risk of chronic lung disease in survivors at 28-30 days (RR 0.53; 95% CI 0.36-0.76).
In certain situations (gas trapping, severe lobar emphysema), a low-volume strategy appears to be more appropriate (Greenough, 1999).

**Evidence Level: I**

**What are the indications for endotracheal suction during HFOV?**
No information with which to answer this question has been identified.

**How should an infant be weaned from HFOV?**
New Zealand guidelines (Battin, 2001) recommend the following:
- Reduce FiO2 to < 40% before weaning MAP (except when over-inflation is evident)
- Reduce MAP when chest x-ray shows evidence of over-inflation (> 9 ribs)
- Reduce MAP in 1 -2 cm increments to 8-9
- In air leak syndromes (low volume strategy), reducing MAP takes priority over weaning the FiO2
- Wean the amplitude in 4 cm H2O increments
- Do not wean the frequency
- Consider switching to conventional ventilation when MAP < 10 cm H2O, Amplitude 20 - 25 and blood gases satisfactory
- Suction is indicated for diminished chest wall movement indicating airway or ET tube obstruction or if there are visible/audible secretions in the airway
- Avoid in the first 24 hours of HFV, unless clinically indicated
- Avoid hand-bagging during the suctioning procedure: use PEEP protector and continue with patient on the ventilator
- Increase FiO2 following the suctioning procedure
- MAP may be temporarily increased 2-3 cm H2O until oxygenation improves

A recent review (Mehta, 2004) states that “Routine scheduled assessments of readiness for weaning and extubation may be more important than specific weaning modes and weaning criteria.”

Battin M. Newborn services clinical guidelines: High frequency ventilation (HFV). 2001


**Evidence Level: V**

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Should an infant be extubated directly from HFOV or weaned to conventional ventilation first?
Weaning to conventional ventilation is common clinical practice (Courtney, 2002), although a technique known as “sprinting” (Seller, 2001) has been used in some difficult cases to achieve extubation directly from HFOV.


Evidence Level: V

Last amended March 2010