# High frequency Jet Ventilation during initial management, stabilization and transport of newborn infants with Congenital Diaphragmatic Hernia: A case series

Jason Macartney RRT[1], Lita Sampaio BSc, RRT[1], Qianshen Zhang MD[2], Karel O'Brien MD, BCh BAO,FRCPC[2,3]

1. Department of Respiratory Therapy, Mount Sinai Hospital, Toronto, Ontario.
2. Department of Pediatrics, Mount Sinai Hospital, Toronto, Ontario.
3. Department of Paediatrics, University of Toronto

## Background

High frequency ventilation is a generally accepted method of providing a lung protective strategy of ventilation to infants born with Congenital Diaphragmatic Hernia (CDH). Much of the published literature describes the use of High Frequency Oscillatory Ventilation despite there being limited options to transport term infants while providing this therapy. There is little published that describes the use of High Frequency Jet Ventilation (HFJV) during stabilization and transport of these infants. The objective of this study was to review our site's experience of the transport and stabilization of infants with CDH who were treated with HFJV.

## Methods

A retrospective chart review was performed of all infants with an antenatal diagnosis of CDH who were delivered at Mount Sinai Hospital, a perinatal referral centre for fetal anomalies. Fifty-five infants with CDH were born between January 01, 2004 and December 31, 2009. Data was abstracted from records of the resuscitation, stabilization and transport of these infants. The infants were transported through a tunnel which adjoins MSH to the Hospital for Sick Children (HSC); the paediatric surgical site. The parameters reviewed included the initial steps taken during resuscitation, initial ventilation settings and acid-base balance. Hemodynamic status, criteria for starting HFJV, pharmacological support, time and length of the transport as well as any complications that arose in transit were also reviewed.

## Results

55 infants were born with antenatally diagnosed CDH during the study period. HFJV was used at some point in the management of 25 infants, which is 45% of all the CDH births. The mean birth weight (+SD) and gestational age (± SD) of the infants was 2868 (± 820) gm and 37.2 (± 3.3) weeks respectively. Sixteen were male and 9 female which corresponds to nearly a 2:1 male predominance. The defect was left-sided in 78% (19/25), right-sided in 20% (5/25), and bilateral in 4% (1/25) of cases. Ten infants (40%) had congenital anomalies other than CDH; 9 (36%) infants had known or suspected congenital heart disease, one with micrognathia and small kidneys, and one with bilateral pelviectasis also had a heart defect. Seven of the infants were born preterm (gestational age < 36+6 weeks).

Seven of the 25 infants died at MSH prior to transport. The remaining 18 were transferred to HSC, two on conventional ventilation and 16 on HFJV. Of the seven infants who died, one had a bilateral CDH and cardiac disease, two had right sided hernias (one with cardiac disease), four had left sided hernias (two with multiple anomalies and one with cardiac disease). One infant was transported on conventional ventilation because a provincial transport service was utilized that did not offer HFJV. The other infant was put back to conventional ventilation because of difficulties managing on HFJV with secretions.

HFJV was the initial mode of ventilation used in six cases because of concerns about the severity of disease on antenatal ultrasound. In the remaining 18 infants HFJV was used as a rescue therapy for severe respiratory acidosis or hypoxemia despite maximal conventional ventilation parameters. MSH follows a protocol for managing CDH that defines failure of conventional ventilation as respiratory acidosis or hypoxemia despite PIP>25cm$H_2$0 or MAP>12cm$H_2$0. Two of the 25 infants developed pneumomediastinums and four had pneumothoraces, three of whom died. The diagnostic X-rays were performed after going on HFJV so it is difficult to assess the timing of the insult.

Twenty one of the infants had at least two blood gases procured from the umbilical artery before and/or after the initiation of HFJV and were found to have significant improvement in blood gases. For the comparison of pre and post measurements of $PaCO_2$ and pH, paired t-test was used. There was significant difference detected for both PaCO2 ($p=0.0002$) and pH ($p<0.0001$). All of the infants were sedated with either morphine or fentanyl and 88% (22/25) were paralyzed with Pavulon. Ten infants were transported on inhaled nitric oxide (iNO). Seven received surfactant and five were treated with $PGE_1$.

The pre and post transport vital signs remained stable and no transport related deaths or significant patient complications occurred. The average length of transport was 30 minutes.

**Conclusions**

HFJV appears to be a safe and effective method of providing high frequency rescue therapy for infants with CDH failing conventional mechanical ventilation. HFJV con also be provided safely and efficaciously on land transport. This review supports the decision to utilize HFJV as it likely contributed to the safe transport of many infants that would not otherwise have tolerated transport to a surgical centre.