Volume Diffusion Respiration (VDR)

A therapy with many uses

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VDR ventilation has been used to treat patients with:

- ARDS
- Meconium Aspiration
- Burn and Inhalation Injury
- RDS of the Newborn
- Apnea of Prematurity
- Air Leaks
So how does it work?
Spasm
Collapse
Swelling
Hyperinflation
Sputum
Pulsatile Flow
To improve PaO2
To decrease PaCO2

“I” time;
Start at:
2 seconds (adult)
1.5 seconds (pedi)
1 second (NICU)
To improve PaO2
To decrease PaCO2

O/CPAP
To improve PaO2
OR
To decrease PaCO2

Looks much more confusing than it really is!
Pressure

Time

- HF: 500 cycles/min
- Each cycle: 0.12 sec
- i time: 0.04-0.06 sec
- e time: 0.06-0.08 sec

Bi-Phasic Pulsatile Flow Ventilation

Point to remember: Mean and Amplitude are linked which is different from a 3100 where they are independent.
Flow Ventilation™ Waveform Changes Related to Compliance of the Lung

Convective Pressure Rise
-How we (Valley Health, VA) use it-

- Add 5-10 cmH₂O above PIP for recruitment, but you can add it without ↑PIP.
- “Gives the lung time to get out of its own way”
  - Slow-responding lung areas
- Philosophy Issue:
  - Start w/ convective rise
  - Add it only for recruitment
Looks much more confusing than it really is!
Pressure–time curves obtained with HFPV (Flow Ventilation™) and PCV during one breathing cycle.

- E: 35 cmH2O/L
- R: 50 cmH2O/L/s
- Frequency: 300 cycles/min.

Note that mean pressure generated by HFPV (Flow Ventilation™) approximates 55% of that produced by PCV.

Volume delivery is always bigger in PCV than HFPV (Flow Ventilation™), in both pathway and in all experimental settings. Volume delivery is less affected by resistive loads variation.

E= 35, 55 and 85 cm H2O/L
R= 5, 20 and 50 cm H2O/L/s

Gas distribution in a two-compartment model ventilated in high-frequency percussive (Flow Ventilation™) and pressure-controlled modes.

WHY VDR® BEFORE; DEC 30TH ‘03

WHY VDR® AFTER 4 DAYS; JAN 2ND ‘04
Surgically removed from patient with 80% burn – couldn’t remove with bronchoscopy

Patient overview

- 3 month old ventilator dependent infant living in nursing facility
- Admitted secondary to bradycardia and desaturation: secondary to pneumonia
- Hx: 38 week 5 day Gestation, BPD, unstable apnea, bronchomalacia, congenital hydrocephalus, hypertension and club feet.
Patient overview

- Date of admission: March 19, 2007
- Frequent lung collapse: atelectasis and infiltrate
- PV maneuver reflected LIP 18-20cmH2O
- Sedated / Paralyzed on vent
- Placed on Flow Ventilation on April 2, 2007
  - Increased thick secretion mobilization noted by RT’s
16 HOURS (4 TREATMENTS)

40 HOURS (10 TREATMENTS)
Single-center retrospective study of 39 pediatric patients supported with Extracorporeal Life Support (ECLS) from January 2008 through May 2013. 22 patients treated prior to May 2011 were ventilated with the Dräger Evita XL served as historical controls, while 14 patients treated after May 2011 were ventilated with the VDR-4 (same PIP and PEEP as conventional ventilation). Pre-ECLS clinical and ventilation parameters were similar in both groups.

- Patients on HFPV had more days alive and off ECLS at both 30 and 60 days. The HFPV cohort had more therapeutic bronchoscopies per patient (2 ± 1) than the historical controls (1 ± 1, p = 0.019).
- More days alive and off ECLS with HFPV
- HFPV utilization was independently associated with ECLS-free days in multivariate analysis

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Nicole Rizkalla et al

- HFPV Improves Oxygenation and Ventilation in pediatric patients with Acute Respiratory Failure
  - “Improved Oxygenation occurred without an increase in Mean Airway Pressure”
  - “Improved gas exchange with HFPV at lower peak-inflating pressures”
  - “83.9% of patients survived to hospital discharge”
  - “In a heterogeneous population of pediatric ARF failing conventional ventilation, HFPV efficiently improves gas exchange in a lung-protective manner.”
Intrapulmonary percussive ventilation in tracheostomized patients: a randomized controlled trial

Objective: to investigate whether the addition of IPV® to the usual chest physiotherapy improves gas exchange and lung mechanics in tracheostomized patients.

Design: Randomized multi-center trial.

Patients: 46 tracheostomized adult patients weaned from mechanical ventilation.

Results: At 15 days the intervention group (IPV®) had a significantly better PaO2/FIO2 ratio and higher maximal expiratory pressure; after follow-up this group also had a lower incidence of pneumonia.

Published, peer reviewed articles

- Over 180 published articles
- Dating from 1984 and consistently growing, most recently
- Initial articles from Burn units regarding inhalation injury showed significant reduction in pneumonia
- Articles and case series in ARDS patients
  - Consistently show improved outcomes for “rescue”
- Articles on both NIV and Invasive Therapeutic applications for:
  - Neonates
  - Pediatrics
  - Adults
What is an “appropriate” PEEP level, from the ARDSnet evidence? The ARDSnet required this table.