

PART NINE

VDR®-4 PERCUSSIONATOR® PROGRAMMING LOGIC

NOTE: Many institutions have their own VDR programming based upon their clinical experiences with available attending. The following programming is considered optimal for maximum clinical efficacy, however is not mandated.

THE VDR-4 is the ONLY UNIVERSAL VENTILATOR WITH HIGH FREQUENCY PERCUSSIVE VENTILATION (HFPV™)

1. IMMEDIATE PRECLINICAL INSERVICE.

- Set up the VDR-4 with gas and power connections- Attach desired institutional VDR® breathing circuit configuration. Make certain heated Humidifier is properly integrated into the VDR® Failsafe Breathing Circuit.
- Attach Patient breathing port of the Phasitron® to the Patient Simulator on the left side of the VDR® Housing.
- Rotate all alpha control knob arrows under their indexes except DEMAND CPAP full clockwise- OFF.

Alpha control knob colors and alpha coding have specific meanings:

Green knobs are for selection of Inspiratory and Expiratory Flowrates.

Yellow knob is for DEMAND CPAP/PEEP selection for weaning- to remain full (clockwise) OFF with VDR® function Switch selected-ON.

DEMAND CPAP is for pressure support only, for use during spontaneous breathing with the VDR® Switch- rotated to-OFF.

Grey knobs are for (High Frequency) PULSATILE FREQUENCY and i/e Ratio control with resultant Frequency selections.

Black are for general INSPIRATORY and EXPIRATORY TIME (convective) I/E phasing Intervals.

Nebulizer Gas Flow into the yellow interfacing tubing is provided by an OFF-ON Toggle Switch.

Normal Operational Pressure Regulator selection (with MASTER SWITCH-OFF) is 42 psig shown on Operational Pressure Gauge.

Note : Basic conventional internal monitoring consists of PROXIMAL AIRWAY PRESSURE monitoring presented on the Manometer. If during patient programming an INTEGRATED MEAN PROXIMAL AIRWAY PRESSURE is desired on the MANOMETER, select INTEGRATED MANOMETER-ON.

Battery operated DISCONNECT MONITORING, is located on right facing side of VDR-4 housing. Toggle Switch to ON for Starting, with Onset Time control knob Arrow under the 12:00 index.

Sustained pressure rise alarming is determined by Red SENSITIVITY knob selection, normally with the control knob Arrow at the 12:00 position a sustained pressure of over 100 cm H₂O has to be maintained for over two (2) seconds to activate alarming and associated proximal airway pressure drop.

FOR DIGITALIZED VENTILATOR MONITORING- PROGRAM MONITRON® II.

Monitron- ON. Scale- 0-60. Sweep- 0.00 to 5.00.

2. For general programming- Select an FIO₂ of 60%. THEN:

- a). Rotate all Alpha control knobs until their arrows are under their 12:00 indexes except Yellow DEMAND CPAP/PEEP control knob rotated full (clockwise).
- b). Black INSPIRATORY TIME- control knob Arrow rotated under the 12:00 index for about a 2 second Inspiratory Interval.
- c). Black EXPIRATORY TIME- control knob Arrow rotated under the 12:00 index for about a 2 second Expiratory Interval.
- d). Green OSCILLATORY CPAP/PEEP- control knob rotated (counterclockwise) until 3:00 is under the 12:00 index position.
- e). Rotate Master switch to- ON.

RESET MONITRON® ALARM

OBSERVE: A two step increase in oscillatory (PIP) on the Monitron Screen.

- a). First stage is the OSCILLATORY BASELINE created by an Oscillatory Demand CPAP selection of between 5-10 cm H₂O.
- b). Second stage is created by PERCUSSIVE FLOWRATE selection of about 25-35 cm H₂O.

Note: It is recommended NOT to use yellow DEMAND CPAP/PEEP during VDR programming. If elected, do not use more than 4 cm H₂O of DEMAND CPAP/PEEP during OSCILLATORY DEMAND CPAP programming. Non-oscillatory, DEMAND CPAP/PEEP is generally reserved for pressure support during spontaneous breathing to reduce the work of breathing.

Note: If DEMAND CPAP is selected with a programmed OSCILLATORY DEMAND CPAP, it will program an accumulative increase.

3. PREPARE FOR PATIENT AIRWAY CONNECTION.

FIRST- DISCONNECT BREATHING HEAD FROM THE SIMULATOR. THEN:

- a). Rotate MASTER Switch to- OFF.
- b). Service Nebulizer/Humidifier.
- c). Toggle NEB switch up to- ON.
- d). Use patient's SAT to determine FIO2 selection.
- e). Rotate MASTER switch back- ON

4. MAKE PHYSIOLOGICAL AIRWAY CONNECTION.

RESET MONITRON ALARM

Observe chest pulsation for BASAL bilateral oscillation.

Monitor PULSE OX for an increase in saturation.

To increase Saturation progressively Rotate the PULSATILE FLOWRATE control knob Arrow (counterclockwise) to increase the AMPLITUDE (PIP) of Percussive Oscillation up to about 35 cm H₂O or until the bottom of the Oscillatory Wave starts to depart the Baseline (usually about 40 cm H₂O).

IMPORTANT-The PULSATILE FLOWRATE control knob Arrow should NOT be rotated (counterclockwise) beyond the point where the Oscillation down stroke departs the Baseline. This will provide for a Manometer reading of about 35 to 40 cm H₂O.

If recruitment is not reached- increase the INSPIRATORY TIME INTERVAL by rotating the INSPIRATORY TIME control knob Arrow (counterclockwise) to about the 03:00 index position for about 5 to 7 second INSPIRATORY INTERVAL.

VERY IMPORTANT- If recruitment is still not obtained, rotate the CONVECTIVE PRESSURE rise control knob Arrow (counterclockwise) initially to about the 02:00 index position. Observe a third step pressure rise to oscillatory PIP on the Monitron Screen.

Wait for recruitment or effect of updated programming. DO NOT CHASE PROGRAMMING WITHOUT ALLOWING COMPENSATION TIME.

5. PROCEDURAL LOGIC-

After a period of Ventilatory Stabilization Check SAT, or blood-gas determinations to determine Oxygenation.

- a.) The Black INSPIRATORY TIME control knob determines the period of OSCILLATORY EQUILIBRIUM providing for Intrapulmonary MECHANICAL GAS MIXING TIME.
- b.) The Green PULSATILE FLOWRATE control knob should be used to control oscillatory PIP up to 40 cm H₂O.
- c.) The Green CONVECTIVE PRESSURE RISE control knob Arrow should be gradually rotated (counterclockwise) to increase oscillatory PIP to pressures above 40 cm H₂O until recruitment is obtained. Over 100 cm H₂O PIP's can be generated, by CONVECTIVE PRESSURE RISE.
- d.) When PIP's exceed 50 cm H₂O check for airway obstruction by observing a pulsatile bilateral inflation of the lung bases.
- e.) To decrease CO₂ or to mobilize and raise retained endobronchial secretions re-program the VDR® as follows:

FIRST write down the existing VDR® program by alpha control knob and clock numbers relative to their respective positions.

- a.) Rotate the PULSE FREQUENCY and i/e RATIO control knobs until 09:00 is under their 12:00 indexes.
- b.) Rotate the CONVECTIVE PRESSURE RISE control knob Arrow full (clockwise) OFF.
- c.) Immediately, rotate the PULSATILE PRESSURE control knob Arrow full (counterclockwise).
- d.) Observe a moderate bilateral oscillatory percussion of the lung bases.

NOTE: In a compliant lung the Percussive Amplitude can be decreased by the progressive (clockwise) rotation of the PULSATILE FLOWRATE control knob Arrow.

- e). Increase the **INSPIRATORY TIME** interval by rotating the control knob (counterclockwise) until 03:00 to 04:00 is under the index, to increase endobronchial mechanical gas mixing.
- f). Periodically over about fifteen minutes rotate the i/e **RATIO** control knob Arrow (clockwise and counterclockwise) to develop an air distal to raise mobilized secretions.
- g). Increase the **INSPIRATORY TIME** interval by rotating the control knob Arrow (counterclockwise) until 03:00 to 04:00 is under the index.
- h). The above Intrapulmonary Percussive Ventilation (IPV®) is usually programmed for about 15 minutes.

NOTE: The use of Vasoconstrictor Bronchodilator aerosols during the period of Intrapulmonary Percussive Ventilation can enhance airway caliber by reducing Mucosal and Sub Mucosal edema as well as Bronchiolar spasm.

- i). Re-program back to initial recorded previous programming.

NOTE: Lung recruitment during Intrapulmonary Percussive Ventilation (IPV®) programming may enable a decrease in oscillatory PIP.

Note: If using a cuffed endo-tracheal airway tube- deflate cuff until a "noticeable but not excessive airway leak" can be determined, to cause mobilized and raised secretions, to enter the pharyngeal areas for oral suctioning as well as, to reduce the re-circulation of CO₂.

If required, increase the **PULSATILE FLOWRATE** to compensate for the leakage caused by the de-flational adjustment of the Cuff.

6. GENERAL ON PATIENT PROGRAMMING.

After at least fifteen minutes of stabilized ventilation, with a stable SAT without noticeable CO₂ retention, run a blood gas determination.

If hypo-ventilation is suspected or revealed:

- a). First increase the PULSATILE FLOWRATE until the oscillatory baseline starts to leave the baseline (usually from 35 to 40 cm H₂O).**
- b). Increase the INSPIRATORY TIME interval by rotating the control knob until 03:00 to 04:00 is under top 12:00 index to increase the Oscillatory Equilibrium Time, to enhance Intrapulmonary Gas Mixing.**
- c). To further increase intrapulmonary gas exchange- gradually rotate the Green CONVECTIVE PRES. RISE control knob (counterclockwise) to increase oscillatory PIP. Observe an increased periodic oscillatory bilateral phasic chest excursion.**
- d). If recruitment is not reached by a 50 cm H₂O PIP CONVECTIVE PRES. RISE**
- e). Program Intrapulmonary Percussive Ventilation as described above under E).**
- f). Use SAT and clinical judgment to determine oscillatory PIP while observing a uniform by-lateral pulsatile chest excursion.**

NOTE: Lungs with very very low compliance may require clinical judgment in terms of oscillatory PIP increases into higher lung compartments with associated MEAN INTRAPULMONARY PRESSURE increases, induced by selected CONVECTIVE PRES. RISE selection.

- g). After about fifteen minutes of stabilization determine PaO₂ and PaCO₂.**

Note: Press RESET and SET on Monitron to re-schedule alarms after any change in programming.

7. TREND ANALYSIS-

Note: IMPORTANT- When making TREND ANALYSIS changes in ventilatory parameters, wait a few minutes for each change to take effect before starting the next choice.

If PaO₂ is low the options are:

- a). Increase- FiO₂.
- b). Increase INSPIRATORY TIME by rotating black control knob Arrow (counterclockwise) until 03:00 to 04:00 is under the 12:00 index.
- c). Re-program- OSCILLATORY DEMAND PEEP/CPAP- rotate green control knob arrow (counterclockwise) to increase pulsatile baseline upward toward 15 cm H₂O do not exceed 20 cm H₂O. Monitor the effect of increased mean intrathoracic pressures upon cardiac output.
- d). Increase- PULSE FREQUENCY- rotate Grey control knob (counterclockwise) until rate is increased above 600 cycles per minute.
- e). Decrease- EXPIRATORY TIME- rotate Black control knob arrow (clockwise) under the 12:00 index for about a 2 second Expiratory Interval.
- f). Increase- CONVECTIVE PRES. RISE- gradually rotate Green control knob (counterclockwise) increasing oscillatory PIP until recruitment and/or clinical judgment is optioned, based upon pulmonary compliance.

If PaCO₂ is high the options are:

- a). Rotate- Grey FREQUENCY and PULSE i/e RATIO- control knobs (clockwise) until 10:00 is under their indexes. This programming creating larger sub tidal deliveries for CO₂ "wash out".
- b). Increase- EXPIRATORY TIME- by rotating black control knob arrow (counterclockwise) for a 3 to 4 second expiratory time.
- c). Increase- CONVECTIVE PRES. RISE- by rotating Green control knob arrow (counterclockwise) using PIP incremental increases of 5 cm H₂O or a clinical judgment call.

NOTE: For maximal CO₂ recruitment follow E). above.

8. To decrease ventilatory assistance by reference to an improved blood gas analysis.

- a). A suggested method of initial weaning after reductions in Fio₂, is to gradually first reduce the CONVECTIVE PRES. RISE then PULSATILE FLOWRATE in gradual steps, which reduces the entire program incrementally.
- b). If initial weaning is too rapid, reverse weaning by increasing Green PULSATILE FLOWRATE control knob (counterclockwise) in 1 (one) index incremental steps.
- c). Gradually- reverse order for programmed O₂ or CO₂ management.

9. TO WEAN.

- a). Gradually- reduce FIO₂ to under 30%.
- b). Gradually- reduce Green CONVECTIVE PRES. RISE to OFF full (clockwise).
- c). Gradually- reduce Green PULSATILE FLOWRATE.
- d). Watch oscillatory PIP reduction rate during weaning to maintain acceptable blood gases.**
- e). Observe chest- for rhythmic spontaneous breathing. THEN:
- f). Discontinue Percussive Oscillatory Ventilation- Rotate MASTER switch to OFF.
- g). Immediately, Adjust yellow DEMAND CPAP to prevent sternal retraction in neonates and/or notable increased work of spontaneous respiration, in pediatric or adult patients.**
- h). Do not reduce DEMAND CPAP below 5 cm H₂O until ready to extubate.**
- i). Use non-invasive Mask or Nasal Prongs for non-invasive ventilation after extubation if desired.
- j). If blood gases indicate weaning too rapidly, MASTER back- ON. reverse order of weaning.

10. POST RECOVERY- Use IPV® to maintain optimal airway recruitment.

Note: There are many unique programming schedules for VDR (HFPV™), established by Clinicians over the past twenty plus years, secondary to on patient experiences.

IMPORTANT NOTE: IF at any time obstructed airways, atelectasis or interstitial edema is suspect- program the VDR® for Intrapulmonary Percussive Ventilation (IPV®).

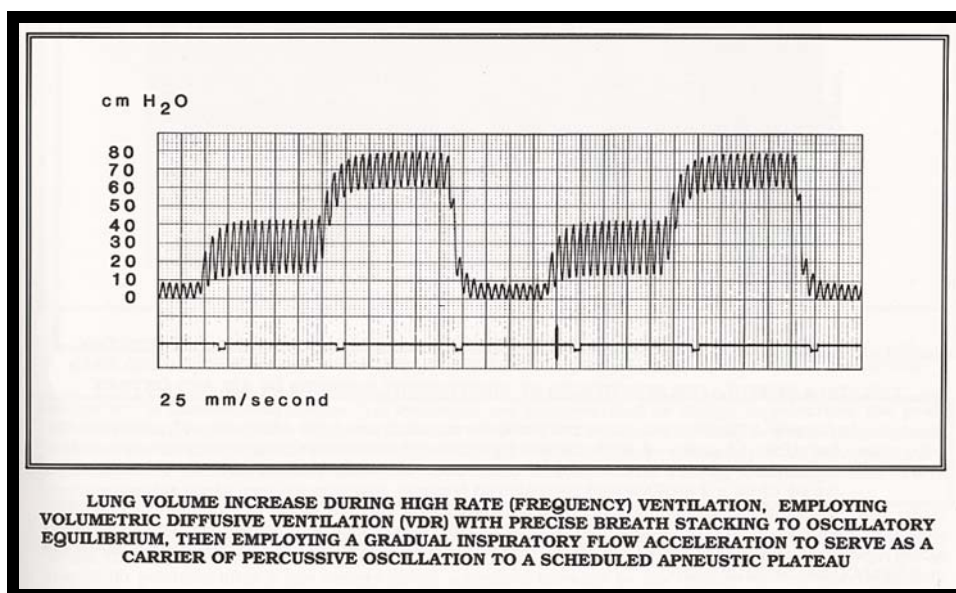
FIRST: Rotate CONVECTIVE PRES. RISE control knob Arrow full (clockwise) to- OFF

1. Rotate (high frequency), PULSE FREQUENCY and i/e RATIO control knob Arrows (clockwise) with 9:00 under their 12:00 indexes.
2. Rotate PULSATILE FLOWRATE control knob Arrow full (counterclockwise).
4. Increase INSPIRATORY TIME by rotating the control knob Arrow (counterclockwise) between the 03:00 and 04:00 position.
4. Observe bilateral CHEST PERCUSSION for about ten to fifteen minutes.
5. Aspirate pharyngeal and/or proximal airways as required.
6. Return to previous ventilatory program.

USE SIMULATOR TO PRACTICE VDR PROGRAMMING UNTIL COMPETENT

The first *High Frequency PERCUSSIVE Ventilator (HFPV)* designed and clinically proven for the universal treatment of neonates, pediatrics and large adults.

VDR® was released to the US market by the U.S. FDA on October 13, 1989 with the first high frequency percussive programming above 150 cycles per minute to 1250 cycles per minute.



THIS UPDATE IS RESULTANT TO CLINICAL FINDINGS OF 4-29-06