

# VENTILATION: VOLUME-TARGETED (VOLUME GUARANTEE/TARGETED TIDAL VOLUME) ●

## 1/2

*NICE QS193 recommends that preterm babies having invasive ventilation are given volume targeted ventilation in combination with synchronised ventilation*

### DEFINITION

In volume-targeted ventilation (VTV) gas delivery is targeted to deliver a pre-set tidal volume. Inspiratory pressure varies with each breath, depending on resistance and underlying lung compliance. The ventilator measures expired tidal volume ( $V_{te}$ ) and calculates the pressure required to deliver this volume for the next breath. Available as volume guarantee (VG) on Draeger Babylog<sup>®</sup> and targeted tidal volume (TTV) on SLE 5000

### Benefits

- Compared with pressure-controlled ventilation, VTV can reduce:
  - mortality
  - bronchopulmonary dysplasia
  - pneumothorax
  - hypocarbia
  - severe intraventricular haemorrhage and periventricular leukomalacia

### INDICATION

- Primarily used in preterm babies with surfactant-deficient lung disease requiring ventilation
- May be useful in other situations requiring ventilation

### CONTRAINDICATION

- ETT leak >50%
- Caution to be used in situations such as pneumothorax, trachea-oesophageal/bronchopleural fistula; leak may be increased and affect ventilation

### TIDAL VOLUMES TO USE

- $V_{te}$  used as less influenced by ETT leaks
- $V_t$  4–6 mL/kg
- 5 mL/kg reasonable starting volume
- Acute respiratory distress syndrome (RDS) 4–6 mL/kg
- baby <750 g: 5–6 mL/kg (minimum starting volume 3 mL if 6 mL/kg is <3 mL)
- baby 750–999 g: 4.5–5 mL/kg
- baby >1000 g: 4–4.5 mL/kg
- Chronic lung disease: 5–8 mL/kg
- Avoid  $V_{te}$  >8 mL/kg (associated with volutrauma)
- Avoid  $V_{te}$  <3.5 mL/kg (associated with atelectotrauma)
- Change  $V_{te}$  in 0.5 mL/kg increments

### MODE

- VG/TTV combined with SIMV, SIPPV, assist control (PTV) or pressure-support ventilation (PSV)
- VG also available for PC-CMV and HFO modes on Draeger VN-500 ventilator
- In SIMV mode, set rate of  $\geq 40$ /min (baby breaths are unsupported)
- PSV has additional advantage of synchronising inspiration termination.

### PEAK PRESSURES

- Start PIP limit ( $P_{max}$ ) of ~25–30 cm H<sub>2</sub>O
- Once baby stable and gases satisfactory adjust  $P_{max}$  to 5–6 cm H<sub>2</sub>O above average PIP needed to deliver set tidal volume
  - usually set  $\leq 30$  cm H<sub>2</sub>O in preterm babies
- If PIP progressively increases or is persistently high, or if set  $V_t$  not delivered, reassess baby
- PEEP set at 4–6 cm H<sub>2</sub>O

### VENTILATOR RATE

- In baby with poor respiratory drive, use rates of 50–60 bpm
- Lower back-up rates of 30–40 bpm can be used with good respiratory drive

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## 2/2

- Use  $T_{\text{insp}}$  (inspiratory time) of 0.3–0.4 sec; in PSV mode, set maximum  $T_{\text{insp}}$  at 0.5–0.6 sec – actual  $T_{\text{insp}}$  is adjusted by the ventilator
- Set flow trigger sensitivity at 0.2–0.4 L/min

### WEANING

- Pressure weans automatically as lung compliance improves
- Avoid tidal volumes  $<3.5$  mL/kg as increases work of breathing in small babies
- In SIMV, rate reduced to 40 breaths/min. VG/TTV is unhelpful with SIMV rates  $<40$ /min as baby breaths are unsupported. Attempt extubation when:
  - $\text{FiO}_2 < 0.3$
  - MAP falls consistently  $<8$  cm  $\text{H}_2\text{O}$
  - baby has good respiratory drive and satisfactory gases

### TROUBLESHOOTING AND PREVENTING PROBLEMS

#### High $\text{CO}_2$

- Review baby
- Is set  $V_{\text{te}}$  being delivered?
- Is chest expansion adequate?
- Has leak increased? Change baby's position before increasing  $P_{\text{max}}$
- If ETT displaced/obstructed, or pneumothorax suspected, perform chest X-ray

#### Low $\text{CO}_2$

- Decrease  $V_{\text{te}}$  by 0.5 mL/kg but maintain  $\geq 4$  mL/kg ( $\geq 2.5$  mL total volume)
- Change to SIMV
- Lower trigger sensitivity
- Check for water in circuit (auto-triggering)
- Decrease rate by 5–10 bpm (in SIMV mode only)
- Increase PEEP (maximum 8 cm  $\text{H}_2\text{O}$ )

#### Low $\text{SpO}_2$

- Review baby
- Exclude air leaks
- Worsening RDS: may require additional surfactant dose
- Evidence of PPHN [see [Persistent pulmonary hypertension of the newborn \(PPHN\) guideline](#)]
- Increase  $\text{FiO}_2$
- If  $V_{\text{te}}$  not delivered, increase  $P_{\text{max}}$
- Baby may benefit from change to high frequency [see [Ventilation: high frequency oscillatory ventilation \(HFOV\) guideline](#)]
- Exclude congenital heart disease

#### Low $V_{\text{te}}$ alarm

- ETT leak  $>50\%$
- Pneumothorax
- Poor compliance/high resistance: increase  $P_{\text{max}}$

#### Baby persistently tachypnoeic

- Increase  $V_{\text{te}}$  by 0.5–1.0 mL/kg even if gases normal
- Review sedation