

# VENTILATION: SYNCHRONOUS POSITIVE PRESSURE VENTILATION (SIPPV) • 1/3

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

## DEFINITION

A form of synchronous ventilation in which baby triggers/initiates the breath while ventilator does the work of breathing. In other words, rate of ventilation is determined by baby while pressures are determined by operator via ventilator

## SETTING UP TRIGGER VENTILATION

- Set humidifier temperature at 39°C (negative 2) to achieve airway temperature of 37°C

### Set up Babylog® (Drager)

- Flow 6–10 L/min
- Select SIPPV mode
- Select highest trigger sensitivity (1: bar is all unshaded)
- Select  $T_{\text{insp}}$  (inspiratory time) between 0.3–0.4 sec
- Adjust  $T_{\text{exp}}$  (expiratory time) to achieve back-up rate of 35–40/min
- Peak inspiratory pressure (PIP) 16–18 cm H<sub>2</sub>O
- Peak end expiratory pressure (PEEP) 5 cm H<sub>2</sub>O
- FiO<sub>2</sub> to [achieve target SpO<sub>2</sub> for gestation \(see Oxygen saturation targets guideline\)](#)

### Set up SLE 5000/6000

- Select patient triggered ventilation (PTV) mode
- Select highest trigger sensitivity (0.2 L/min for ≤28 weeks' gestation, 0.4–0.6 L/min for >28 weeks' gestation). Look at baby to confirm triggering adequately by observing baby generated breaths are triggering ventilator support
- Select  $T_{\text{insp}}$  for back-up breaths between 0.3–0.4 sec
- Set back-up rate of 35–40/min
- PIP 16–18 cm H<sub>2</sub>O
- PEEP 5 cm H<sub>2</sub>O
- FiO<sub>2</sub> to [achieve target SpO<sub>2</sub> for gestation \(see Oxygen saturation targets guideline\)](#)
- Software allows compensation for a leak of 10–60%
- Observe tidal volume (Vt) settings to confirm between 4–6 mL/kg

### Baby

- If gestation <34 weeks, consider loading baby with IV caffeine citrate (20 mg/kg)
- Discontinue sedation

## INITIATING TRIGGER VENTILATION

- Once baby connected to ventilator:
  - check SpO<sub>2</sub> (see [Oxygen saturation targets guideline](#)) and adjust FiO<sub>2</sub> accordingly
  - check baby's chest moving adequately, and measured Vt. Chest expansion should be just visible, and Vt should be between 4–6 mL/kg. If not, adjust PIP/PEEP to maintain adequate oxygenation and ventilation
  - check ventilator triggering in synchrony with baby. Assess by **listening** to ventilator while **watching** baby's respiratory effort

*Most likely cause of baby 'fighting' ventilator is ASYNCHRONY (see Management of asynchrony)*

## SUBSEQUENT ADJUSTMENTS ON SIPPV

- Check blood gas within 30 min of initiation of SIPPV
- Aim for:
  - PaO<sub>2</sub>: 6–10 kPa [or target appropriate SpO<sub>2</sub> level](#)
  - PaCO<sub>2</sub>: 4.5–8.5 kPa day 1–3, 4.5–10 kPa day 4 onwards
  - pH >7.25

### To improve oxygenation

- Increase FiO<sub>2</sub>
- Rule out pneumothorax
- Increase PIP and/or PEEP

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- Increase  $T_{\text{insp}}$  (not more than 0.4 sec)

## To decrease $\text{PaCO}_2$

- Rule out pneumothorax
- Increase PIP
- Check if baby triggering adequately. If not, try shortening  $T_{\text{insp}}$ , or increasing back-up rate

## Low $\text{PaCO}_2$

- Decrease PIP
- Decrease back-up rate if  $>35/\text{min}$  (if baby not breathing above this rate)
- In a vigorous hypocapnic baby, transfer to synchronised intermittent mandatory ventilation (SIMV) at a rate of at least 20/min

## GENERAL SUPPORT

- Monitor  $\text{SpO}_2$  continuously
- Check arterial blood gases at least 4–6 hrly depending on stage of disease
- In babies successfully ventilated in SIPPV mode, sedation is unnecessary
- Remember, most common cause of baby fighting ventilator is ASYNCHRONY. Always carry out checks and adjustments (see **Management of asynchrony**)
- If baby still 'fights' ventilator, consider morphine bolus (50–100 microgram/kg)
- If baby continues to 'fight' ventilator, use continuous sedation and change to other conventional ventilation (SIMV) mode (see **Ventilation: conventional** guideline)

***Do not use muscle relaxants unless, despite carrying out above checks, baby cannot be ventilated. If muscle relaxants necessary, revert to conventional ventilation (see Ventilation: conventional guideline)***

## NURSING OBSERVATIONS

### While baby on SIPPV, hourly observations

- Back-up rate set
- Baby's own respiratory rate
- $V_t$  (in mL)
- Minute ventilation [MV (in 1/min)]

### If alarm goes off, check

- Synchrony between baby and ventilator
- Excessive water droplets in ventilator tubing
- Flow graph for evidence of blocked tube or excessive  $T_{\text{insp}}$
- Disconnection

## MANAGEMENT OF ASYNCHRONY

### Checklist

- Is endotracheal tube (ETT) patent (look at flow graph and  $V_t$ )
- Is  $T_{\text{insp}}$  too long? (is baby exhaling against ventilator?), if so shorten  $T_{\text{insp}}$  to 0.3 sec
- Is back-up rate too high? If so, consider dropping to 30–35 breaths/min
- Is there water condensation in ventilator tubing?
- If all above fails, consider morphine bolus (100 microgram/kg) over 3–5 min
- If baby still continues to 'fight' ventilator, use continuous sedation and revert to SIMV

## AUTOCYCLING (FALSE TRIGGERING)

- False triggering occurs when ventilator delivers a mechanical breath artefactually when baby not actually initiating a spontaneous respiration
- Usually results from presence of water droplets in ventilatory circuit, or an excessive ETT leak
- If baby's trigger rate appears to be in excess of 80/min, ensure this is actual rate by observing baby's own respiratory movements. If not:
  - check ventilatory circuit for excessive water condensation and empty if necessary
  - decrease trigger sensitivity by increasing trigger threshold e.g. from 0.4 to 0.6 L/min
  - Look for amount of ETT leak on Babylog display. If in excess of 50%, consider changing to slightly wider ETT

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## WEANING FROM SIPPV

- Once baby stable (triggering above set rate, saturating in  $\text{FiO}_2 < 0.3$ ), wean by:
  - decreasing PIP by 1–2 cm  $\text{H}_2\text{O}$  each time (in SIPPV/PTV mode, weaning rate in a baby who is already triggering above it is useless)
  - check baby breathing regularly and effortlessly (no chest recessions), and blood gases and oximetry are acceptable
  - once PIP between 14–16 cm  $\text{H}_2\text{O}$  (depending on size of baby), consider extubation
  - assess need for nasal CPAP/high-flow by checking for chest recessions, spontaneous minute ventilation, and regularity of breathing
- During weaning  $\text{PaCO}_2$  can rise above 7 kPa and  $V_t$  may fall below 4 mL/kg
  - provided baby triggering well, is not visibly tired, and  $\text{pH} > 7.25$ , no action required
  - if poor triggering, visibly tired or abnormal pH, increase PIP, and later back-up rate