SYNCHRONOUS POSITIVE PRESSURE VENTILATION (SIPPV)

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 H₂O
- Peak end expiratory pressure (PEEP) 4 cm H₂O
- FiO₂: 0.4–0.6

Set up SLE 5000 using version 4.3 software upgrade
- Flow is fixed in SLE at 5 L/min
- Select PTV (patient triggered ventilation) mode
- Select highest trigger sensitivity (0.4 L/min for <28 weeks’ gestation, 0.6–0.8 L/min for >28 weeks’ gestation). Look at baby to confirm triggering adequately by observing baby generated breaths are triggering ventilator support
- Select Ti (inspiratory time) for back-up breaths between 0.3–0.4 sec
- Adjust rate to achieve back-up rate of 35–40/min
- Peak inspiratory pressure (PIP) 16–18 cm H₂O
- Peak end expiratory pressure (PEEP) 4 cm H₂O
- FiO₂: 0.4–0.6
- Termination sensitivity is set at 5% (machine will vary it 5–50%)
- Software allows compensation for a leak of 10–50%
- Observe tidal volume settings to confirm between 4–6 mL/kg

Baby
- If gestation <34 weeks, consider loading baby with IV caffeine citrate (20 mg/kg) according to local guidelines
- Discontinue all sedation

INITIATING TRIGGER VENTILATION
- Once baby connected to ventilator:
  ◦ check SpO₂ (target according to local guidelines or 92–95%) and adjust FiO₂ accordingly
  ◦ check baby’s chest moving adequately, and measured tidal volume (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 PaO₂ between 6–10 kPa, PaCO₂ between 5–7 kPa and pH >7.25

To improve oxygenation
• Increase FiO₂
• Rule out pneumothorax
• Increase PIP and/or PEEP
• Increase T_{insp} (not more than 0.4 sec)

To decrease PaCO₂
• Rule out pneumothorax
• Increase PIP
• Check if baby triggering adequately. If not, consider shortening T_{insp}, or increasing back-up rate by decreasing T_{exp}

Low PaCO₂
• Decrease PIP
• Decrease back-up rate if >35/min
• In a vigorous hypocapnic baby, transfer to SIMV (synchronised intermittent mandatory ventilation) at a rate of at least 20/min

GENERAL SUPPORT
• Monitor SpO₂ continuously
• Check arterial blood gases at least 4–6 hrly depending on stage of disease
• In infants successfully ventilated in SIPPV mode, sedation 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 (100 microgram/kg)
• If baby continues to ‘fight’ ventilator, use continuous sedation and change to conventional ventilation (IPPV/IMV) mode

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

NURSING OBSERVATIONS
While baby on SIPPV, hourly observations
• Back-up rate set
• Baby’s own respiratory rate
• Tidal volume (Vt in mL)
• Minute ventilation (MV in 1/min)

If problems, check
• Synchrony between baby and ventilator
• Excessive water droplets in ventilator tubing
• Flow graph for evidence of blocked tube or excessive Ti

MANAGEMENT OF ASYNCHRONY
Checklist
• Is ET tube patent (look at flow graph and Vt)
• Is T_{insp} too long? (is baby exhaling against ventilator?), if so shorten T_{insp} to 0.24–0.3 sec
• Is back-up rate too high? If so, consider dropping to 30–35 breaths/min by increasing T_{exp}
• Is there water condensation in ventilator tubing?
• If all above fails, consider morphine bolus (100 microgram/kg)
• If baby still continues to ‘fight’ ventilator, use continuous sedation and revert to IPPV/IMP
AUTOCYCLING (FALSE TRIGGERING)
- False triggering occurs when ventilator delivers a mechanical breath artifactually when baby not actually initiating a spontaneous respiration
- Usually results from presence of water droplets in ventilatory circuit, or an excessive ET tube 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
  - look for amount of endotracheal tube leak on Babylog display. If in excess of 50%, consider changing to slightly wider ET tube

WEANING FROM SIPPV
- Once baby stable (triggering above set rate, saturating in FiO₂ < 0.3), wean by:
  - decreasing PIP by 1–2 cm H₂O 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 H₂O (depending on size of baby), consider extubation
  - assess need for nasal CPAP by checking for chest recessions, spontaneous minute ventilation, and regularity of breathing
- During weaning PaCO₂ can rise above 7 kPa and Vt may fall below 4 mL/kg
  - provided baby triggering well, is not visibly tired, and pH > 7.25, no action required
  - if poor triggering, visibly tired or abnormal pH, increase PIP, and later back-up rate