

Clinical Guidelines and Observations
on Babylog 8000 plus with
Pressure Support Ventilation (PSV)
and Volume Guarantee (VG)

Important Notice:

Medical knowledge changes constantly as a result of new research and clinical experience. The author of this introductory guide has made every effort to ensure that the information given is completely up to date, particularly as regards applications and mode of operation. However, responsibility for all clinical measures must remain with the reader.

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1 Introduction

Software 5 introduces a new user interface on Babylog 8000 plus with an improved alarm package, pulmonary function monitoring (compliance, resistance, C_{20}/C) and leak adaptation. Leak adaptation derives the instantaneous magnitude of endotracheal tube leakage throughout the respiratory cycle. The measured flow is then corrected accordingly to allow for maximal trigger sensitivity without autocycling and to allow reliable breath termination during Pressure Support Ventilation¹⁾ (PSV) (see below) in the face of significant leak (up to about 40 %). The combination of PSV with Volume Guarantee¹⁾ (VG) leads to the most complete degree of synchronization and gives the infant the most control over the respiratory pattern.

¹⁾ Pressure Support Ventilation and Volume Guarantee are Options and not standard in Software Release 5.0

2 Pressure Support Ventilation

2.1 Principles of operation

PSV is a time-cycled, pressure-limited synchronized mode in which each spontaneous breath is supported like in Assist/Control mode and a backup rate is set to maintain adequate support in case of apnea. The major difference is that inspiration is ended when inspiratory flow declines to 15% of peakflow. In this fashion inspiratory hold is eliminated and the chance of active expiration against positive pressure is minimized, further decreasing asynchrony.

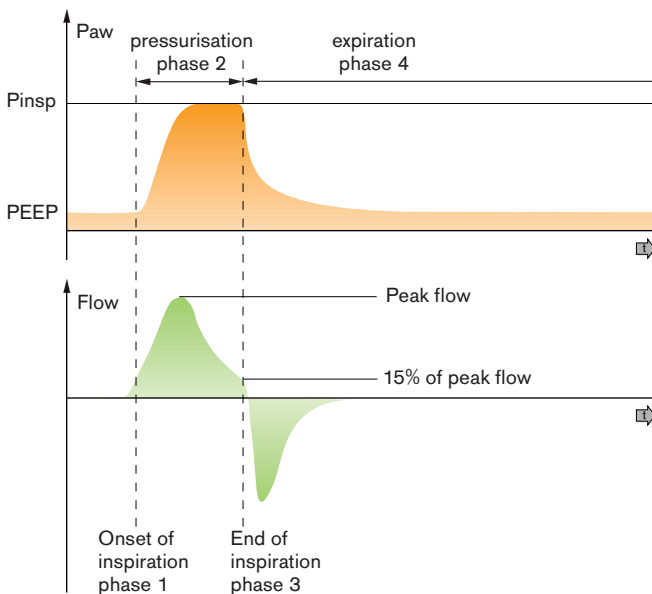


Figure 1: Pressure and airway flow signals during a PSV breath, showing the four phases: Recognition of the beginning of inspiration, pressurization, recognition of the end of inspiration and expiration.

2.2 Advantages

- PSV allows the infant more control over respiratory pattern with synchronization at the end of inspiration, not just the beginning.
- PSV maintains optimal T_i for a given patient and automatically adjusts to changes in time constants.
- PSV allows the infant to sigh as needed with pressure support being given throughout the sigh. This is important in the prevention of atelectasis.
- PSV should reduce the risk of barotrauma and, possibly, of IVH, because it reduces BP fluctuations implicated in the genesis of IVH in preterm infants. (These presumed benefits have yet to be documented.)

2.3 Indications

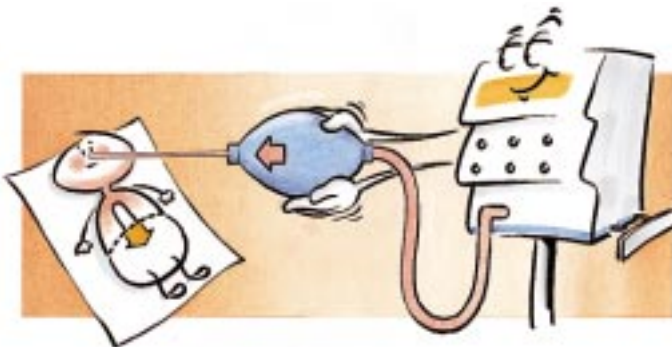
Virtually any infant requiring mechanical ventilation.

2.4 Contraindications

- A brief period when prolongation of T_i with inspiratory hold is desired to recruit diffusely atelectatic lungs. N. B.: This should not be required for more than 10-15 minutes.
- Once recruited, lung volume is maintained with adequate PEEP and the PSV mode can be activated.

2.5 Clinical Guidelines

- Set the T_i at the maximum value you are willing to allow in case of failure to terminate or removal of the flow sensor.
- Spontaneous T_i for small preterm infants with RDS is approximately 0.25 seconds with sighs of up to 0.5 second long. Larger babies have slightly longer spontaneous T_i because their time constants are longer (Time constant is the product of compliance and resistance). Conceptually this represents the time it takes for pressure to equilibrate and gas flow to cease when a step change in pressure is applied at the airway opening. Approximately 3 time constants are needed for 95% equilibration).
- Usual upper limit setting for T_i is 0.4 seconds for infants < 1 kg and 0.6 seconds for larger infants.
- Remember that the actual T_i is under the control of the baby and will usually be in the range of 0.25 - 0.30, except when the infant sighs.



3 Volume Guarantee

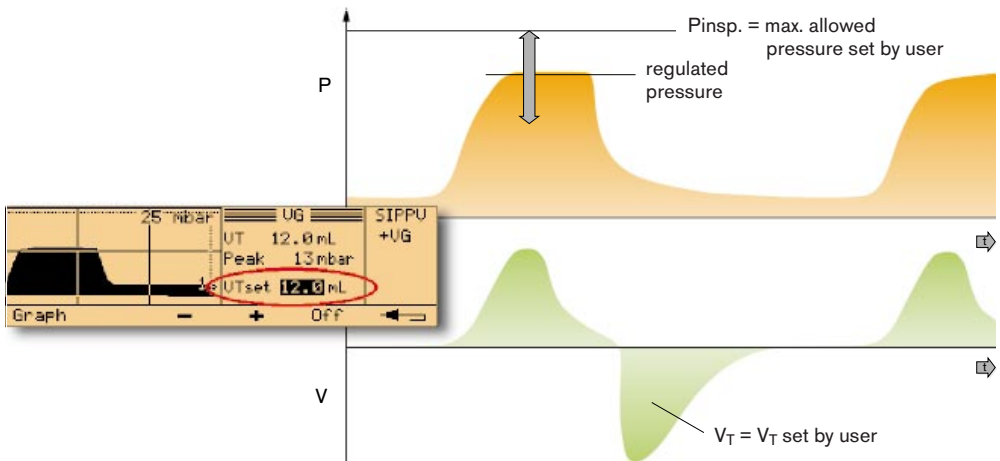
3.1 Principles of operation

Increased recognition of the importance of lung overdistention in the development of lung injury (volutrauma) has caused a renewed interest in accurate control of delivered tidal volume (V_T). Unlike the volume controlled ventilators used in older patients, the Babylog measures V_T at the airway opening during expiration. This eliminates the problems of variable leak around uncuffed endo-tracheal (ET) tubes and unpredictable loss of volume to compression of gas in the circuit and humidifier, as well as stretching of the circuit, which together render traditional volume controlled ventilation completely impractical in small preterm infants. Additionally, the decelerating flow pattern common to all pressure-limited time-cycled ventilators provides improved gas distribution in the lungs compared to traditional volume controlled ventilation.

Volume guarantee can be combined with any synchronized standard mode of ventilatory support. It is a time-cycled, pressure-limited mode in which the microprocessor that operates the device automatically adjusts the delivered peak inspiratory pressure (PIP) to achieve a target V_T set by the operator. The operator also sets the limit of PIP up to which the pressure can be adjusted. If this pressure is not sufficient to deliver the target V_T within the alarm delay limit, an alarm notifies the operator of the problem.

Because in this mode the adjustment of PIP is in response to expired V_T and adjustments are made in limited increments to avoid the risk of overcompensation, the PIP cannot be adjusted instantaneously to compensate for large breath-to-breath fluctuations in respiratory effort. Consequently, the delivered tidal volume, while certainly more constant than in the

absence of Volume Guarantee (VG), does fluctuate somewhat around the target value. Infants can (and frequently do) take spontaneous breaths that have a larger V_T than the set target.



3.2 Advantages

- The VG mode automatically compensates for changes in compliance, resistance and spontaneous respiratory effort. It is especially useful in the acute phase of respiratory illness when compliance changes rapidly, either spontaneously or with administration of surfactant.
- VG is also very useful in infants with periodic breathing and apnea who are on maintenance respiratory support.
- The alarm function, when used appropriately, will alert staff to worsening lung compliance which may require immediate attention (e.g. pneumothorax, atelectasis).

Figure 2: Working principle of Volume Guarantee. According to a set tidal volume inspiratory pressure is automatically regulated by the ventilator.

- The PIP is weaned automatically and in real-time as lung compliance improves with resolution of the lung disease. This should, theoretically, lead to faster weaning from mechanical ventilation.

3.3 Indications

Virtually any infant requiring mechanical ventilation, especially when lung mechanics are likely to change rapidly or the patient has a variable respiratory effort, periodic breathing or apnea.

3.4 Contraindications

None. (Cannot be successfully used if endotracheal tube leak is > 40%.)

3.5 Clinical Guidelines

3.5.1 Initiation

- VG should be implemented immediately upon initiation of mechanical ventilation, as this is the time when most rapid changes in lung mechanics are likely to occur.
- The usual starting target V_T is 4-5 ml/kg during the acute phase of the illness.
- Larger V_T may be needed in older infants with chronic lung disease because of increased physiologic dead-space [wasted ventilation due to poor ventilation/perfusion matching].
- The PIP should be set about 15-20% above the PIP currently needed to deliver the target V_T in order to give the device adequate room to adjust PIP.
- It is important to chart not only the PIP limit but also the actual delivered PIP.



3.5.2 Subsequent adjustments

- Subsequent adjustment to target V_T may be made based on PaCO_2 . (This is seldom necessary). The usual increment is 0.5 ml/kg.
- The PIP limit needs to be adjusted from time to time (usual increment 1-2 cm H_2O) in response to changing lung mechanics in order to maintain the PIP limit sufficiently close to the actual PIP and at the same time avoid frequent alarms.
- N.B. If the flow sensor is temporarily removed (such as around the time of surfactant administration), if its function is affected by reflux of secretions or surfactant, or it malfunctions for any reason, the delivered pressure will default to the PIP limit. Therefore it is important to keep the PIP limit sufficiently close to the actual PIP to avoid volutrauma.
- If the infant appears agitated with episodes of spontaneous hyperventilation, consider light sedation (avoid oversedation with complete suppression of respiratory effort).

- If the infant is persistently tachypneic ($RR > 80$), consider increasing the V_T target even if the $PaCO_2$ and pH are normal, because this suggests the infant's work of breathing is excessive. (However, if the $PaCO_2$ is low and the RR is high, sedation may be indicated).
- If the low V_T alarm sounds repeatedly, increase the pressure limit *and investigate the cause* of the change in lung mechanics (e.g. atelectasis, pneumothorax, pulmonary edema, etc.)
- If the pressure limit has to be increased substantially and/or repeatedly, verify that the tidal volume measurement is accurate (assess chest rise, obtain a blood gas) and, if true, seek the cause of the change in lung mechanics (examine the patient, obtain CXR).

3.5.3 Weaning

- When the target V_T is set at the low end of the normal range (usually 4 ml/kg) and $PaCO_2$ is allowed to rise to the low to mid 40's mmHG, weaning occurs automatically as PIP is lowered in response to improving compliance and increasing spontaneous respiratory effort ("self-weaning").
- If the V_T is set too high and/or the $PaCO_2$ is too low, the baby will not have a respiratory drive and will not "self-wean". Instead, he will become dependent on the ventilator due to lack of respiratory muscle training.
- Avoid oversedation during the weaning phase.
- If an infant appears to not be weaning as expected, despite apparently improving lung disease, try lowering V_T to 3.5 or even 3 ml/kg, as long as blood gases are adequate and the work of breathing does not appear excessive.

- If significant oxygen requirement persists, PEEP may need to be increased to maintain mean airway pressure as PIP is automatically lowered.
- Most infants can be extubated when they consistently maintain V_T at or above the target value with delivered PIP < 10-12 cm H₂O (< 12-15 cm H₂O in infants > 1 kg) with FiO_2 < 0.35 and good sustained respiratory effort.
- Observing the graphic display of the delivered PIP is helpful in assessing for periodic breathing (variable respiratory effort) that may require methylxantine administration to facilitate extubation.

4 Clinical Case Report 1

Baby Boy C is a 10 minute old 1200 g 29 week preterm infant. He was intubated at 3 minutes of age due to inadequate respiratory effort and moderate retractions and grunting. He responded well to bag ventilation and now that his endotracheal tube has been secured he is placed on a Babylog ventilator in A/C mode with the following settings: PIP 24 cm H₂O, PEEP 6, Ti 0.30, rate 40, FiO₂ 0.60. His breath sounds are equal, he has good chest wall movement and the delivered V_T is 6 ml. The pulse oximeter is reading 98 % saturation and all is well. The physician proceeds to place UAC and UVC and, after some difficulty, he is successful. The FiO₂ is weaned to 0.30 during the catheter placement. The procedure takes 45 minutes and the ABG obtained at the end of the procedure shows pH of 7.55, PaCO₂ of 29 mmHG, PaO₂ of 89 mmHG and BE of -1.

What happened? The initial settings were appropriate and the delivered V_T was 5 ml/kg which should not result in hyperventilation. Most likely, the infant's lung compliance improved rapidly due to clearance of lung fluid and volume recruitment with positive pressure ventilation. In fact, inspection of the minute ventilation trend confirms that the minute ventilation was rising steadily. The V_T is now 8.5 ml/kg. The infant was under drapes and his excessive chest rise was not noticed.

The physician recognizes that this problem could have been avoided if the VG mode had been employed. He proceeds to switch to VG with target V_T of 6 ml (5 ml/kg) and sets the PIP limit at 22 cm H₂O. ABG done 20 minutes later shows pH of 7.35, PaCO₂ 43 mmHG, PaO₂ of 79 mmHG and BE of -1.5. The actual PIP generated by the ventilator ranges from 18 - 20 cm

H₂O. Satisfied with the result, the physician checks the CXR, confirms ET tube position and the clinical impression of RDS and proceeds to administer surfactant. Another ABG is drawn 45 minutes after surfactant is given and the following results are obtained: pH of 7.57, PaCO₂ 23 mmHG, PaO₂ of 89 mmHG and BE of -1.9.

What is going on now?!? The problem is that, as per policy in some NICUs, the flow sensor was taken out of the circuit during and after surfactant administration to avoid fouling it with refluxing surfactant. When the flow sensor is inoperative, the VG function is disabled and the PIP defaults to the pressure limit, in this case 22 cm H₂O. This is clearly excessive, because compliance has improved further due to surfactant administration.

The flow sensor is replaced and the physician notes that now the PIP needed to deliver the 6 ml V_T is in the range of 14-16 cm H₂O. He adjusts the PIP limit to 18 cm and turns his attention to other matters. The next ABG reveals pH of 7.34, PaCO₂ 44 mmHG, PaO₂ of 73 mmHg and BE of -2.1. The infant appears comfortable and has an adequate respiratory effort.

Over the next 48 hours the ABGs remain in the normal range and the delivered PIP comes down to 12-14 cm H₂O with FiO₂ of 0.27. On occasion the infant is noted to generate V_T greater than 6 ml with little or no pressure delivered by the ventilator. At this point he is successfully extubated to CPAP of 5 cm H₂O.

This is an example of autoweaning. As long as the V_T setting is low enough to permit normal respiratory drive, the PIP will automatically come down as lung compliance and spontaneous effort improve.

5 Clinical Case Report 2

Baby girl C is a 6 hour old 980 g, 27 wk gestation infant with mild RDS. She received two courses of antenatal steroids and her mother was treated with MgSO₄ for preterm labor. The infant was intubated in the delivery room for poor respiratory effort. Initial settings on PSV+VG mode were FiO₂ of 0.45, PIP 20 cm H₂O, PEEP 5 cm H₂O, Ti 0.40 sec., rate 40, target V_T of 5 ml/kg. Initial ABG revealed pH of 7.39, PaCO₂ of 39 mmHg, PaO₂ of 83 mmHg and BE of -2.1 with delivered PIP of 16-18 cm H₂O. Subsequent two blood gases were similar. The FiO₂ was weaned to 0.24 and the PIP limit was decreased to 16 cm H₂O because, following surfactant administration, the delivered PIP has ranged from 12-15 cm H₂O. The infant is becoming more active and has improved spontaneous effort with intermittent agitation. The nursing staff wondered if sedation may be appropriate, but the Neonatal Fellow is concerned about possible depression of the infant's respiratory effort. The next ABG shows pH of 7.49, PaCO₂ 29 mmHg, PaO₂ of 63 mmHg and BE of -3.4. The Fellow decides to lower the target V_T to 4 ml and repeats the ABG in one hour. Alas, the hyperventilation persists. The V_T target is lowered to 3 ml and repeat ABG ordered. The Fellow is chagrined to find his patient even more alkalotic than before and calls his attending for advice.

What gives? This infant does not appear to have severe lung disease. Her respiratory effort was probably initially suppressed by high magnesium level and now that this has resolved, she is breathing well above the set V_T during her periods of agitation. This is easily confirmed by observing the measured V_T and the PIP graphic display. If the measured V_T is substantially above the set value for significant periods of time and the delivered PIP is

near the PEEP level during that time (as it should be, since the ventilator will bring the pressure down in response to the larger-than-desired V_T) it is clear that the baby is spontaneously hyperventilating. This is usually due to agitation, particularly at the time of handling of the infant and can be treated with careful sedation. Lowering the target V_T further accomplishes nothing, since the infant is breathing well above even the original target V_T .

To correct the problem and get the nurses off her back the Fellow orders PRN morphine sulfate 0.1 mg IV. She also returns the target V_T to 4 ml, realizing that the V_T target setting was not the problem. The agitation subsides and the next ABG shows normal pH and PaCO_2 but the infant remains tachypneic. The nurse decides to give another dose of morphine when the tachypnea persists for another hour. Soon after, the low V_T alarm starts to go off repeatedly. When the nurse gets tired of silencing the annoying alarm the significance of which is unclear to her, she notifies the Fellow. The bleary eyed budding Neonatologist struggles out of bed and trudges to the bedside. She notes that the V_T is only reaching 2.5 to 3 ml and the chest wall movement is inadequate. Figuring that, if the V_T is low it needs to be increased, she orders the target V_T to be set at 5 ml and heads back to the call room. Before her head even hits the pillow the phone rings and the nurse complains that the low V_T alarm is still going off. "Raise the limit to 6 and get a gas" she mumbles and falls back to sleep, only to be aroused 15 minutes later with the ABG that is not what she wanted to hear: the PaCO_2 is 60 mmHg with pH of 7.21! "And, by the way", complains the nurse, "that darn alarm is still going off."

It is clear that our budding Neonatologist has not fully grasped the working principle of VG. She fails to realize that the V_T is low because either the compliance or the infant's respiratory effort (in this case both-see below) have changed and the ventilator cannot achieve the set V_T because it has reached the PIP limit. Increasing the target V_T is not going to change anything, because the V_T is not directly controlled - this is still pressure-limited, time-cycled ventilation. The ventilator adjusts the PIP to reach the target V_T , but it must be given sufficient pressure limit to achieve the desired result. The correct response would have been to increase the PIP limit as needed and to investigate the reason for the change.

After consulting with the senior respiratory therapist the Fellow recognizes her error and orders the PIP to be increased to 20 cm H₂O and the V_T target back to 5 ml. Unfortunately, the alarm persists with V_T below target despite the delivered PIP at the PIP limit. The FiO₂ is back up to 0.65 with marginal saturations. The PIP is then raised to 24 cm H₂O but the V_T is still not consistently meeting its target. The Fellow, now fully awake, recognizes that this is a big change in PIP and wants to make sure that the V_T measurement is accurate. She asks the Respiratory Therapist to change the flow sensor and orders a CXR. The new flow sensor shows the same V_T and an ABG is still marginal with PaCO₂ of 55 mmHg. The CXR shows poor lung expansion with diffuse haziness bilaterally with no other pathology.

Comment. The physician is appropriately concerned about the magnitude of the change and wants to make sure the device is working properly (it is, the hypercarbia confirms accuracy of the flow measurement without the need to change the sensor). Next, she appropriately seeks the cause of the clinical change. In this case the infant was clearly oversedated with 2 doses of morphine given close together. The persistence of tachypnea after the first dose of morphine was due to the relatively low V_T setting (4 ml/kg) with the baby no longer agitated, but compensating for increased work of breathing by increasing respiratory rate. The second dose led to suppression of respiratory effort and development of diffuse atelectasis due to low V_T with poor respiratory effort. It turned out, in retrospect, that the infant was contributing a great deal to her minute ventilation and when this was knocked out, it unmasked the fact that she did have significant lung pathology. The atelectasis, of course, adversely affected lung compliance which, along with the absence of spontaneous respiratory effort, led to the dramatic rise in the required PIP.

The PIP limit is increased to 26 cm H₂O and PEEP to 7 cm H₂O to re-recruit the atelectatic lungs. Within an hour the FiO_2 is back to <0.30 indicating improved ventilation/perfusion matching due to resolution of atelectasis. The delivered PIP is down to around 20 cm H₂O with appropriate V_T . As the infant gradually wakes up from her narcotic oversedation and resumes her strong respiratory effort, the PIP is further reduced. Agitation is controlled with a non-narcotic sedative and physical comfort measures. The infant

now demonstrates sustained respiratory effort with good gas exchange on delivered PIP ranging from < 10 to 14 cm H₂O and is extubated at 36 hours of age to CPAP of 5 cm H₂O.

6 Clinical Case Report 3

Baby girl H is a six day old 700 g 25 week gestation micropremie who has been on A/C+VG since soon after birth. The respiratory course has been relatively benign with moderate initial settings and good response to surfactant. The VG mode has functioned well, maintaining the target V_T at around 5 ml/kg and the PaCO₂ in the high 30 mmHg. Current settings are PIP limit of 16 cm H₂O, PEEP of 4 cm H₂O, target V_T 3.5, rate 40 min, Ti 0.25, FiO₂ 0.28. The baby appears fairly close to extubation, with apparently good spontaneous respiratory rate and the actual delivered PIP is fluctuating between < 10 and 16 cm H₂O. However, the Neonatal Nurse Practitioner (NNP) is concerned that there has been no significant progress in terms of weaning for the past 48 hours and is unsure of how to proceed from here to facilitate extubation.

It is likely that part of the problem is a relatively generous V_T (5 ml/kg) considering that the goal is weaning off the ventilator. Lowering the target V_T to 3 ml (approx. 4.3 ml/kg) would be a good initial step that should allow the PaCO₂ to rise into the low to mid 40 mmHg and encourage the infant to more actively take over.

Following the advice of the Neonatologist, she lowers the target V_T to 3 ml and is gratified to see the delivered PIP come down to the range of < 10 to 14 cm H₂O. However, she notes that over the next 8 hours the FiO₂ rises to 0.45 and the baby becomes more tachypneic. The Respiratory Therapist suggests switching the infant to PSV +VG, because he recalls another attending making this change in a similar situation. After some discussion the PSV mode is activated with no other change in settings.

Disappointingly, there is no apparent improvement in the baby's status.

The suggestion was probably appropriate, but the execution flawed. The increasing oxygen requirement suggests the development of microatelectasis, probably because of the fairly low V_T and low PEEP. The T_i is very short. Switching to PSV would allow the infant to control his T_i and receive support during his attempt to sigh. It would be appropriate to raise the PEEP as well at this point to maintain lung volume once it is recruited. Even very premature babies have the ability to sigh as a means of recruiting lung volume, but because of their prematurity may not do so effectively without support. PSV will support a more effective sigh only if the T_i limit is increased to accommodate a normal sigh (approximately 0.40 sec for this baby). Most breaths will continue to have a much shorter T_i as before, since it is the baby now who decides the length of inspiration.

Now that the T_i is adjusted appropriately the baby returns to an FiO_2 of <0.30 and is holding his own. Respiratory effort seems adequate and ABGs are good. Delivered PIP is usually <12 cm H_2O . He is extubated and placed on CPAP of 5 cm H_2O via nasal prongs. He does well initially but soon develops frequent apnea and bradycardia. After several hours of this he is electively reintubated and placed back on his pre-extubation settings. The Respiratory Therapist who just came on the new shift spends a few minutes observing the Babylog graphic display and announces that the problem is obvious and the extubation failure was predictable. The Neonatal Nurse Practitioner wants to know what on earth he knows that she doesn't.

The Respiratory Therapist has noticed that the baby's respiratory effort is quite intermittent. When the infant breathes spontaneously the V_T is at or above the set V_T target with virtually no delivered PIP (the pressure waveform is virtually flat). However, he sees that quite often there is a prolonged period of apnea during which the PIP would rise up to near the PIP limit to compensate for the lack of spontaneous effort. Because VG compensates so effectively, the baby clinically appears to be doing well. When such a pattern is observed, it is likely that the infant will not tolerate extubation. Methylxantines are usually helpful in this situation.

The infant is given a loading dose of caffeine and, after confirming the resolution of the intermittent respiratory pattern on the graphic display for several hours, is successfully extubated to nasal CPAP of 5 cm H_2O .

7 Clinical Case Report 4

Baby M is a two week old former 24 week old 620 g micropremie who has failed two attempts at extubation despite caffeine. She remains on a Babylog ventilator in A/C mode with minimal settings: PIP is 13 cm H₂O, PEEP 4 cm H₂O, rate 40/min. and Ti 0.30. The FiO₂ fluctuates between 0.21 and 0.40. The nurses are frustrated by their inability to maintain pulse oximetry readings within usual limits. The alarms are going off constantly and the nursing staff is surreptitiously widening the alarm limits in an effort to maintain their sanity and be able to attend to their other patient. The infant is occasionally agitated, but sedation has made little difference. The nurses wonder if the patient is “shunting”. The Neonatologist is reminding them about the dangers of hyperoxia and insists that the saturation limits must be observed. Luckily, the Dräger representative just happens to be in the unit demonstrating the new software upgrades and suggests that she may have the answer to this baby’s problem. The infant is placed on PSV with VG mode with the following settings: PIP limit 15 cm H₂O, PEEP 4 cm H₂O, target V_T 2.8 ml (4.5 ml/kg) rate 40/min. and Ti 0.40. As if by magic, the pulse oximetry reading stabilizes and the FiO₂ is quickly weaned to 0.25 where it remains. The Dräger representative’s stock has risen dramatically, but the staff want to know what really happened.

The VG option is very useful in infants who are ventilator dependent because they have an immature respiratory pattern with severe periodic breathing/apnea. Without VG such a baby is known as “dial-a-baby”, because the pulse oximeter is constantly alarming either high or low, forcing the nurse to make frequent adjustments in FiO₂.

Unfortunately, she can never find the “right” level. This is because of alternating episodes of hypoventilation with desaturation and compensatory hyperventilation with return of good oxygenation. This is evident from the jagged pattern of the graphic display of the trend of minute ventilation. If this is not intuitively obvious, remember that in A/C or PSV, the delivered V_T is the result of the combined “effort” of the baby and the ventilator (every breath is supported). When the infant has a fairly stable respiratory effort it is easy to find the right PIP. In a baby with periodic breathing this is not the case. In a spontaneously breathing infant the PIP is set at an appropriate level for the combined “effort” of the ventilator and the infant to deliver a normal V_T . When the baby becomes apneic, the “effort” of the ventilator alone does not deliver a sufficient V_T . The resulting hypoventilation eventually leads to a fall in oxygen saturation. When the baby “kicks in” and often briefly hyperventilates to blow off CO_2 , oxygenation rapidly improves. The FiO_2 has been turned up in the meantime, thus the constant alarms. VG will even out the fluctuations by compensating for the intermittent lack of effort on the part of the baby and then back off (bring the PIP down) when the infant “kicks in.” When you switch such a baby to VG the noise level in the NICU will drop dramatically and nurses will love you!

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