

**PROCEDURE FOR:** Application of Continuous Positive Airway Pressure (CPAP) to Infants via Nasal Prongs or Nasal Mask

**RATIONALE:** Nasal continuous positive airway pressure (NCPAP) is the application of positive pressure to the spontaneously breathing infant throughout the respiratory cycle. A variable flow device or mechanical ventilator provides heated humidified flow through a circuit that applies positive pressure through a mask or prongs. The elevated positive pressure during the inspiratory and expiratory cycle result in an increase in functional residual capacity (FRC), and a decrease in airway resistance in the infant with unstable lung mechanics. In addition, NCPAP also expands or stents the upper airway structures, preventing collapse and upper airway obstruction. This decreases the work of breathing and potentially reduces the oxygen requirement of the infant.

**PERSONNEL:** Respiratory Therapists

**INDICATIONS:** NCPAP is generally initiated at levels of 4-5 cm of H<sub>2</sub>O and may be gradually increased as per medical orders to provide the following:

1. NCPAP is responsive to clinical conditions listed below:
  - a. Atelectasis
  - b. Apnea of prematurity
  - c. Recent extubation
  - d. Chronic lung disease
  - e. Respiratory Distress Syndrome
2. Decrease work of breathing as indicated by a decrease in respiratory rate and a decrease in the severity of retractions, nasal flaring and grunting.
3. Achieve arterial or capillary blood gas values; the ability to maintain a PaO<sub>2</sub> > 50 torr with FiO<sub>2</sub> of < .60 while maintaining and adequate minute ventilation indicated by a PaCO<sub>2</sub> of 45-60 torr and a pH ≥ 7.2.
4. Improvement in appearance of lung as indicated by chest radiograph.

**PROCEDURE:** Continuous Flow Ventilator: CPAP pressure is delivered by varying the resistance to exhalation at the exhalation valve. The CPAP can be increased or decreased through adjusting the resistance.

**NCPAP Interface:**

1. NCPAP is initiated by obtaining the appropriate nasal prong and bonnet size. The appropriate prong size provides an adequate seal with minimal air leakage.
2. The prong size is determined by utilizing the weight table and through visual assessment. The prongs should be inserted 1/3 to 1/2 inside the nares, be snug in placement without blanching the skin.

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3. The bonnet can be stretched to fit all head sizes. It is stretched from the forehead over the head and covering the occipital area. The ears should be covered and lying flat.

**Ventilator Set-Up:**

1. Attach continuous flow ventilator to oxygen and air sources.
2. Attach heated wire circuit to inspiratory and expiratory ports of the ventilator.
3. Insert Concha Column into the humidifier and connect to the water bottle.
4. Adjust temperature setting to maintain 34 degrees centigrade. Ensure that the ventilator is turned on prior to turning on the humidifier.
5. Remove proximal airway sensor from the ventilator circuit.
6. Place inspiratory circuit into the corrugated tubing of the CPAP assembly.
7. Place expiratory limb into opposite side of CPAP assembly.
8. Attach proximal pressure line to "T" connector on inspiratory circuit of the Bear Cub ventilator. Remove "T" connector from inspiratory circuit when using Draeger ventilator.
9. Set alarms according to departmental policy.
10. Turn base flow on with Bear Cub ventilator or inspiratory flow on with Draeger ventilator to 6-8 lpm.
11. Set FiO<sub>2</sub> with oxygen dial.
12. Place bonnet on infant's head starting at the forehead.
13. Occlude prongs and set CPAP to ordered level.
14. Open prongs and insert into infant's nares as described above.
15. With CPAP in place adjust Velcro straps as necessary.
16. Monitor pressure fluctuations on manometer and adjust flow to maintain minimal negative deflections during each spontaneous breath.
17. Complete and document full patient assessment in the respiratory flow sheet.

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**Variable Flow Generator (Infant Flow System):** Variable flow employs a flowing gas source. When the gas flow rate is altered the delivered pressure will change. The generator utilizes the fluidic flip mechanism which causes the direction of the gas on inspiration to be directed through the prongs and upon exhalation the gas is directed away from the prongs into the expiratory limb reducing the work of breathing.

**NCPAP Interface:**

1. NCPAP is initiated by selecting the appropriate nasal prong/mask and bonnet size. The appropriate prong/mask size provides an adequate seal with minimal air leakage.
2. The prong size is determined by choosing one of three size prongs (small, medium or large). When the prongs are inserted inside the nares, the seal is snug without causing blanching of the skin. There should be some space between the prong set and the infant's nose.
3. Correct bonnet size is attained through measurement of the head or weight of the infant dependent upon manufacturer's recommendation. Measurement of the head begins at the nape of the neck, across the middle of the ear and across the top of the eyebrow. The edge of the bonnet is to be placed at the eyebrow line, extending over the entire skull to the nape of the neck. The ears are to be covered and lying flat.

**Infant Flow Set-Up:**

1. Attach infant flow to air and oxygen sources.
2. Attach circuit to humidifier outlet and to infant flow generator.
3. The infant flow circuit and generator is threaded through the side ports of the isolette to minimize torque and pulling of the generator.
4. Insert Concha Column into humidifier and connect to the water bottle. Adjust temperature setting to maintain 34 degrees centigrade. Ensure that the infant flow is turned on before turning on the humidifier.
5. Attach prongs/mask to generator.
6. Turn infant flow on, set flow to 8 lpm, occlude the prongs and verify the PEEP reads 5.
7. Turn on humidifier and set to 34 degrees Centigrade.
8. Set the FiO<sub>2</sub> using the air/oxygen dial.
9. Place bonnet on infant's head as described above.

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10. Occlude prongs/mask, adjust flow to the ordered CPAP. Refer to nomogram attached to infant flow for liter flow required to deliver desired CPAP.
11. Open prongs and place in infant's nares.
12. Velcro/tie the 2 clear tubings to the bonnet.
13. Extend exhalation tubing to outside of isolette. The exhalation tubing should **not** be attached to bonnet.
14. Adjust tiedown straps/Velcro to secure bonnet.
  - a. The neck of the infant should be in neutral position.
  - b. The nose of infant should be in normal position and not pushed upwards.
15. Set alarms by pressing and holding alarm silence button for three seconds.
16. Complete and document full patient assessment on respiratory flow sheet.

- LIMITATIONS:**
1. Mouth breathing during NCPAP may result in decrease in delivered oxygen concentration and loss of pressure.
  2. Neck extension may alter the NCPAP interface compromising the airway resulting in diminished or altered pressure and affecting the delivered NCPAP.

- COMPLICATIONS:**
1. Obstruction of nasal prongs from mucus plugging may interfere with delivery of pressure and result in decrease in oxygen.
  2. Complete obstruction of nasal prongs results in continued pressurization of the CPAP system without activation of the low or high airway pressure alarms.
  3. Insufficient flow may not meet the inspiratory demand of the infant resulting in an increase in work of breathing.
  4. Excessive flow can result in overdistension from increased work of breathing due to incomplete exhalation and inadvertent PEEP levels.
  5. Lung overdistension may lead to air leak syndromes.
  6. Abdominal distension may potentially lead to aspiration.
  7. Incorrect bonnet/prong sizing may result in nasal redness, philtrum redness, internal swelling, necrosis or excoriation.
  8. Inadequate humidification may produce nasal mucosal damage.

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9. Should the humidifier be powered on and the infant flow turned off, the continuous flow through the humidifier stops, resulting in a bolus of hot air being trapped in the column of the humidifier. Thus, upon turning on the infant flow a bolus of hot air is delivered through the circuit potentially burning the infant's nares.
10. Increased resistance created by turbulent flow through the nasal prongs will maintain pressure in the CPAP system even when decannulation has occurred. This can result in failure of low airway pressure/disconnect alarms to respond.

**CONTRA-INDICATIONS:**

1. Progressive respiratory failure as indicated by  $\text{PaCO}_2 > 60$  torr and  $\text{pH} < 7.25$  torr.
2. Multiple apneic episodes resulting in desaturations and or bradycardia.
3. Cardiovascular instability.
4. Congenital Malformations eg. TEF, Choanal Atresia, Congenital Diafragmatic Hernia.

**APPROVAL:**

**EFFECTIVE DATE:** 3/06

**REVISION DATES:**