Integrated Family Delivered Neonatal Care

Expert in your baby's care

Chapter 7. Ventilation nursing

Parent educational material for app

Imperial Neonatal Service, Imperial College Healthcare NHS Trust

1. Introduction to ventilation in the neonatal unit

Breathing problems are very common in premature babies and often the leading cause of admission of term babies. Therefore helping and supporting them with respiratory support is an important part of neonatal care. In the past, the majority of the neonatal units used invasive forms of ventilation for prolonged periods in extremely preterm infants, as it was felt that their lungs were not mature enough to enable breathing on their own.

Over the last two decades, the majority of units have moved from using invasive to more gentle, non-invasive forms of ventilation, as soon as the baby is ready to maintain oxygen in the blood and has spontaneous breathing effort.

This chapter tells you some basic information and about respiratory care and machines used in the neonatal unit.

Aims for this chapter

We want you as a parent to:

- understand the aims of ventilation
- be familiar with the various forms of ventilatory equipment and machines
- understand about invasive and non-invasive forms of ventilation
- understand how you can work with nurses to provide optimum care to your Baby while ventilated

1.1. Background to neonatal ventilation– when, why and how

The two main functions of the lungs are delivering oxygen to, and the exchange of carbon dioxide from the blood. Any type of machine supporting the breathing of preterm infants and sick term infants facilitates the optimal gas exchange and performance of the lung.

Extremely preterm infants are ventilated at birth because of their inability to maintain a generous volume in the lungs due to deficiency of surfactant (which means that their lungs can collapse without positive airway pressure). Sometimes they need ventilation again later on in life due to sudden deterioration caused by an infection or other complications.

Term infants are ventilated at birth mainly due to infection, inhalation of meconium into the lungs at birth and congenital brain and lung conditions.

Sometimes doctors decide to electively ventilate a sick baby so that they have control of the airway and gas exchange.

Generally, when babies are unwell, or immediately after birth, they are ventilated using an invasive mode of ventilation through an endotracheal tube. The tube will be taken out and the

baby will be allowed to take breaths spontaneously later on when clinicians believe that they will be able to cope without the ventilator. In almost all preterm infants, non-invasive forms of ventilation will then be used for a long time during their journey, with interventions such as continuous positive airway pressure (CPAP) or high flow oxygen, or nasal cannula oxygen.

Most of the babies are weaned off respirator support as they approach their due date. In rare cases, babies are discharged home on oxygen if they develop significant chronic lung disease. In Chapter 6 'Medical conditions and outcomes' you can read more about lung problems in neonates.

1.2. Intubation

An endotracheal tube is a soft plastic tube which needs to be inserted into the windpipe to enable the ventilator to generate or deliver breaths for the baby. Various different sizes of tube are used depending on the birth weight of the baby. The tube is inserted under direct vision using an instrument with a light source called a laryngoscope. If intubated in the neonatal unit, medications are generally given through an intravenous cannula to relax the muscles and minimise injury prior to intubation. The endotracheal tube also enables us to give surfactant directly to the lungs as a therapy for respiratory distress syndrome cause by prematurity.

Figure 1. Extremely preterm baby with endotracheal tube

Doctors and nurses are always vigilant about the position of the endotracheal tube in the lungs. If there is any doubt, a chest x-ray can be done to delineate the position of the tube. The endotracheal tube needs to be suctioned to remove secretions at regular intervals to prevent blockage. This will be done by the nurse looking after your baby during cares.

1.3. Ventilation

Whilst inside the mother's womb, the baby receives all the required oxygen (and other nutrition) from the mother's blood, through the placenta and along the umbilical cord. After birth, they have to use their own lungs to breathe for gas exchange. This is quite difficult for extremely premature babies for two main reasons: firstly, the lungs are not fully developed and are deficient in

Figure 2. Ventilator set up in the neonatal unit

surfactant; secondly, the babies may be unwell and too weak to breathe by themselves. The ventilators used in different neonatal units vary but in essence have the same function.

1.4. Humidity

Figure 3. Humidification of air and oxygen and tubings of a ventilator

You will notice that in any type of machine giving respiratory support, tubes coming out from the machine delivering fresh gas are going through a can containing warm water before being connected to the baby; this enables delivery of moist, humidified air to their lungs. This is very important as dry and cold gas delivered to the lungs may cause injury to the lungs. From time to time the nurses will fill up the water chamber when it becomes empty to allow the humidification.

1.5. Conventional ventilation

In conventional ventilation the baby's lungs are intermittently inflated with an oxygen-air mixture through an endotracheal tube. The rate of breathing is regularly adjusted to meet the requirement of your Baby and will depend on levels of carbon dioxide and oxygen in the blood. These sophisticated machines are designed to enable oxygenation and to remove carbon dioxide from the blood. Different parameters can be set on the machine. Conventional ventilation can be guided by pressure (pressure support, where pressures are set on the machine) or volume (volume guided support, where the breath volumes are set). Although most neonatal units use pressure support, there is an increasing trend of providing volume guided ventilation, especially in extremely preterm infants.

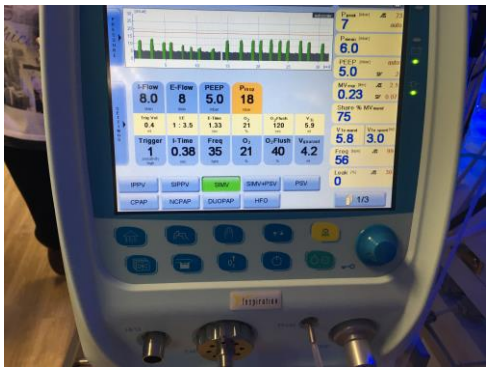

Figure 4. Control panel of a machine using conventional ventilation modes

You can learn how to position your Baby comfortably while on the ventilator. It is possible to have skin-to-skin cuddles while your Baby is ventilated and stable, but this needs a lot of support from the neonatal team.

1.6. High frequency ventilator (or oscillator) (HFO)

Figure 5. Control panel of a machine using High frequency ventilation (HFO) mode

This type of ventilation is used for critically ill children and represents the top level of respiratory care we can provide in neonatology. In high frequency ventilation, or oscillation, the ventilator will blow small amounts of air into the lungs several hundred times a minute.

The baby's chest appears to vibrate or oscillate and although this may look alarming, this type of ventilation is gentle and works extremely well for some lung conditions such as severe respiratory distress syndrome, hypoplastic lungs, diaphragmatic hernia and meconium aspiration.

You can learn how to position your Baby comfortably while on the ventilator. Skin-to-skin holding may not be possible if your Baby is on HFO ventilation and critically ill, but you can still be with your Baby as much as possible.

1.7. Continuous positive airway pressure (CPAP)

Continuous positive airway pressure, also known as CPAP, helps the baby by supplying continuous airflow with under pressure through two soft plastic tubes (prongs) placed in the baby's nostrils or through a small mask placed over the baby's nose. This airflow raises the pressure within the lungs and helps to keep the baby's lungs inflated while they are breathing spontaneously on their own. It is a non-invasive ventilation mode and one of the most frequently used types of respiratory support in the neonatal unit.

Figure 6. Baby receiving CPAP through nasal prong

The majority of preterm babies, especially above 27 weeks, need a little help with their breathing and may or may not need a ventilator. Sicker babies who are initially invasively ventilated, subsequently can be taken off to CPAP, depending on their clinical response. Usually babies need the support for several weeks and can be slowly weaned off.

Weaning can happen in different ways. Sometimes the level of positive pressure is gradually decreased, but more

frequently the baby is given periods of time off the ventilation. These periods are gradually extended – this is called cycling. Another possibility is to switch the baby to high flow or nasal cannula from CPAP when they are ready.

An effective seal is extremely important in this type of ventilation, as the positive pressure has to be maintained. Opening the mouth reduces this, so sometimes a chin strap or a dummy may be used to provide a seal of the mouth to enable optimal delivery of pressure into the lungs.

You can help your Baby by keeping an eye on the seal and making sure that the mask or the nasal cannula does not slip out of the nose. You can also learn how to position your Baby comfortably while on CPAP. You can have skin-to-skin cuddles regularly if your Baby is stable on CPAP.

1.8. High flow

High flow is a gentle form of non-invasive support of the lungs where a high flow oxygen air mixture can be blown through a soft plastic nasal prongs in both nares. It works via a different mechanism to the CPAP. It gives less positive pressure, using air turbulence for support instead.

It is generally used in babies who are stable in terms of their respiratory condition and still need some oxygen and pressure to maintain the volume in their lungs. It is a very popular mode of support for both nurses and parents as it is much more comfortable for babies than CPAP, and it is easier to handle them and facilitate breastfeeding.

You can help your Baby by keeping an eye on the nasal prongs in the nose and making sure that they are appropriately positioned.

Figure 7. Babies receiving high flow through nasal cannula

1.9. Low flow

Figure 7. Baby receiving low flow oxygen through nasal cannula.

Low flow oxygen in given through a small, simple nasal cannula in infants who require some oxygen to maintain adequate saturation levels of oxygen in their blood.

This is a gentle form of support and is generally used as a final stage to wean babies off any oxygen support.

Sometimes babies with chronic lung disease will still require nasal cannula oxygen when they go home. See Chapter 15 'Discharge planning' for more details about discharge planning and home oxygen.

Key messages and reflection:

After this chapter you should be able to:

- understand the importance of providing ventilatory support and different types of machines
- be familiar with the ventilation equipment around your Baby
- learn how you can help your Baby cope while on respiratory support.

Further learning in this topic

If you wish to know more:

- ask our neonatal team at any time
- ask for one-to-one support from one of our Integrated Family Delivered Care Project team
- use this app / your Parent Binder to record notes and questions
- attend small group teaching in topic: **Ventilation in neonatal unit**

Authors

Jayanta Banerjee, consultant neonatologist, Imperial College Neonatal Services

Aniko Deierl, consultant neonatologist, Imperial College Neonatal Services

Ioanna Gozar, Trust fellow, Imperial College Neonatal Services

Resources

Rennie J M (2005) Roberston's Textbook of Neonatology, Fourth Edition

Local neonatal guidelines and Parent information leaflets