Resuscitation Council UK

Air/oxygen blenders and pulse oximetry in resuscitation at birth

Authors
Sam Richmond, 2011
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Introduction

The International Liaison Committee on Resuscitation (ILCOR) in their most recent consensus on science document suggests that “in term infants receiving resuscitation at birth with positive pressure ventilation, it is best to begin with air rather than 100% oxygen”. They then add “If despite effective ventilation there is no increase in heart rate or if oxygenation (guided by oximetry) remains unacceptable, use of a higher concentration of oxygen should be considered”[1]. Recent changes in the Newborn Life Support (NLS) course have emphasised this preference for using air, which has led Course Directors who have implemented these changes to raise some questions.

Why are we worried about high concentrations of oxygen?

It is clear that hyperoxia is damaging to tissues, including the cells of the developing brain, and particularly so after a period of asphyxia. There is a voluminous literature on the subject of resuscitation at birth with oxygen or air[2] and those interested in this question are urged to read the worksheets on this topic to be found on the ILCOR website[3].

Given that air is to be preferred and yet higher concentrations of oxygen are still thought to be useful in certain cases, a number of other questions arise. How does one judge when to offer increased concentrations of oxygen, how much should be offered and for how long?

Additional resuscitation equipment

The need to start resuscitation at birth with air whilst retaining the ability to offer additional oxygen to a small minority of babies means that both gases, and the ability not only to blend them but also to monitor oxygenation, will need to be available at delivery. Many delivery units will have to consider providing access to compressed air, air-oxygen blenders and pulse oximeters.

What if my unit does not have this equipment?

The acquisition of blenders and oximetry should be seen as an aspiration to be fulfilled in the next five years rather than an immediate requirement. Provision of compressed air should be a simpler task. When the NLS course was launched in 1999 the preference for using a mask and T-piece for lung aeration and ventilation rather than a mask and self-inflating bag was a similar aspiration, now largely fulfilled in hospitals throughout the UK.

Which is to be preferred – a T-piece with oxygen only, or a bag-valve system with air?

The T-piece is more reliable in delivering effective lung aeration and ventilation by mask and arguably should be used in preference to bag-valve systems even in the absence of blended gases. The fact that the T-piece allows the operator to control inflation pressures more precisely and to offer PEEP gives this device a considerable advantage. A first step in resolving this dilemma might be ensuring the availability of compressed air for T-piece systems, which should be relatively easy to achieve.

What about births at home?

The need for resuscitation at birth in planned home deliveries is rare. Most midwives use air via bag-valve systems for mask inflation at home. The absence of additional oxygen is unlikely to be of any consequence in this situation.

When to offer increased oxygen concentrations?

If damaging hyperoxia could be avoided, might concentrations of inhaled oxygen greater than 21% result in a faster resolution of cellular asphyxia? This would only be true if it is the concentration of inspired oxygen rather than some other issue, that is the limiting factor to the speed of the processes involved – and there is little evidence to support this view.

It was for this reason that the ILCOR report in 2005 stated “After initial steps at birth, if respiratory efforts are absent or inadequate, lung inflation/ventilation should be the priority. Once adequate ventilation is established, if the heart rate remains low, there is no evidence to support or refute a change in the oxygen concentration that was initiated. Rather the priority should be to support cardiac output with chest compressions and coordinated ventilations. Supplementary oxygen should be considered for babies with persistent central cyanosis[4,5].”

There is no clear, evidence-based recommendation that can be given as to when to offer an increased concentration of oxygen during resuscitation other than when a baby remains cyanosed despite effective ventilation. However the failure of a baby’s heart rate to respond to apparently effective ventilation (confirmed by chest movement) is a reasonable indication that the situation may require an extended resuscitation and at this point the issue of whether higher concentrations of oxygen might prove helpful should be considered (and may, quite reasonably, be rejected) – though the immediate practical response should be to proceed to chest compressions.

In the absence of a heart rate response to lung aeration, establishment of a circulation capable of delivering oxygen to the heart and other organs can only be achieved by effective cardiac compressions with ventilation. The situation will not be influenced by an increase in the inspired oxygen concentration. However, once the heart rate has responded, if the baby remains cyanosed then an increase in oxygen concentration might be considered.

How much supplemental oxygen should be offered and for how long?

When offered other than as air, oxygen is a drug and its dosage should be monitored and adjusted to the baby's response. In the delivery room the most accurate way to monitor administration is to use an air/oxygen blender and the most accurate way of assessing the baby's response is to measure oxygen saturation using a pulse oximeter. This is particularly true in preterm babies. Acceptable right-arm (pre-ductal) oxygen saturation measurements during the first minutes after birth are included in the NLS manual and the UK resuscitation guidelines.

In the absence of both a pulse oximeter and an air/oxygen blender the attendant may, in rare circumstances, have to consider using 100% oxygen and monitoring its effect by judging the heart rate response or colour. This should be avoided where possible or rectified as soon as possible. One cannot accurately assess oxygenation, and particularly hyperoxia, by colour alone.

What if saturation monitoring is not available?

When resuscitating a baby at birth it is important to remain focussed on the fact that control of the airway and aeration of the lung are the two most important factors that will determine the outcome. Fitting a pulse oximeter probe is not a life-saving manoeuvre; though, if done correctly and in a manner that does not interfere with the more important factors, it can supply useful information and a means of reducing the possibility of oxygen overdose – especially in preterm infants. It can also supply a continuous record of heart rate which can be useful in prolonged resuscitation of term infants.

In summary

Though both air/oxygen mixers and pulse oximeters are helpful in resuscitation at birth they are not essential and neither their presence nor their absence should be allowed to interfere with the fundamental simplicity of the task in hand, which is to aerate the baby's lungs.

References

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