RESUSCITATION 144 (2019) 189–190

Available online at www.sciencedirect.com

Resuscitation

journal homepage: www.elsevier.com/locate/resuscitation

Editorial

Face mask respiratory support for preterm infants: Takes their breath away?

Descriptions of the revival of apparently lifeless newborn babies pre-date Christian times.[1] After some curious diversions – electrocution, rectal insufflation of tobacco smoke, alternate immersion in hot and cold water– breathing support became the mainstay of treatment in the last century. In the 1970's, a pattern of resuscitating babies emerged based on studies of acutely and profoundly asphyxiated term Rhesus monkeys.[2] Courses teaching neonatal resuscitation were developed in the 1980s.[3,4] They recommended assessing babies' breathing and heart rate, and giving positive pressure ventilation (PPV) by face mask to those judged to be in poor condition. Endotracheal intubation was recommended for those who didn't respond to mask PPV, and circulatory support for those who still didn't improve despite intubation. A process of evidence evaluation and formulation of treatment recommendations was started by the Neonatal Task Force of the International Liaison Committee on Resuscitation (ILCOR) in the 2000s and continues today.[5]

Many more babies are born prematurely than are born with asphyxia at term, both in developed and developing countries. Though premature babies are not rare, before the 1960s, their long-term survival was. The majority had respiratory distress at or shortly after birth, and usually their condition inexorably worsened, most often resulting in death from respiratory distress syndrome (RDS) within three days. In the 1990s, randomised trials demonstrated that premature babies who were intubated for treatment of RDS survived in markedly greater numbers if they were given exogenous surfactant down the endotracheal tube.[6] As the decade progressed, premature babies were routinely intubated at birth for surfactant.[7] However, concerns that invasive ventilation might cause more chronic respiratory problems for premature babies than non-invasive breathing support that were first raised in the pre-surfactant era[8] persisted after its introduction.[9] Randomised trials that followed in the 2000s demonstrated that starting babies on continuous positive airway pressure (CPAP) and reserving intubation and surfactant for those who fail, was superior to routine intubation for all.[10] Nowadays, we aim to support spontaneous breathing and to intervene to give more support in a timely fashion to those who deteriorate.

The majority of premature babies breathe spontaneously at birth.[11,12] Disappointingly, many of them are intubated shortly thereafter. Though it is not always clear why babies are intubated, a proportion will be due to apnoea despite mask respiratory support. In this issue of *Resuscitation*, Kuypers reports a study of 429 infants born before 33 weeks who received mask breathing support at 2 hospitals between 2010–2018.[13] The majority (86%) breathed spontaneously before the mask was applied. More than half of those who breathed spontaneously stopped for around half a minute when the mask was applied. Babies who stopped breathing had lower heart rate and oxygen saturations over the first minute of life, compared to those who did not stop breathing. The effect was more marked in babies born before 28 weeks. This novel and somewhat revolutionary study reports a lot of high-quality, prospectively collected data on a large number of preterm infants born in the modern era. The main weakness of the study– the absence of a control group that didn't receive mask breathing support– is unavoidable. On enquiry, the authors reported that "only 3/514 babies who were recorded did not receive respiratory support". This is not peculiar to these two centres; the provision of mask respiratory support to premature babies immediately after birth is almost ubiquitous. In a study of 100 preterm infants [mean (SD) GA 29 (3)] at my own hospital, 93 received respiratory support by mask, 72 of them before their heart rate had been determined (unpublished).[14] It appears that "all" clinicians believe that "all" premature babies have or will shortly develop RDS, so they "all need" breathing support. As a result "everyone" gets it through a mask– "sure, what harm can it do?" This study suggests that it may inhibit spontaneous breathing.

Did the application of the face mask inhibit breathing in these babies or was it a temporal association? Were these babies destined to stop breathing anyway? It is not hard to see why masks might cause problems. They were designed for unconscious humans, not spontaneously breathing ones. The authors speculate that activation of the trigeminocardiac reflex may inhibit breathing in these babies. That is certainly one – and not the only – plausible explanation. It is easy to occlude a baby's airway by positioning the head incorrectly.[15] I can imagine that, in the hands of a twitchy neonatologist, a face mask could prove a very effective weapon in the war on spontaneous breathing. However, we need more data. The history of neonatal resuscitation is littered with confusion between temporal association and cause and effect. Just because babies that had tobacco smoke insufflated into the rectum survived, it does not necessarily mean they survived because of it. They may have survived despite it. The same may be said for endotracheal adrenaline. Or mask ventilation, or chest compressions, for that matter.

Efforts to more clearly distinguish "resuscitation" (i.e. reanimation of the nearly dead) from "supporting transition to extra-uterine life" have not been entirely successful. There is major overlap between the two techniques. Both "resuscitation" and "early treatment of RDS" consist of breathing support provided with the same equipment – a manual ventilation device (most often a T-piece) and a face mask.

Both are provided by the same clinicians who have cognitive biases. Even though most premature babies breathe spontaneously, many clinicians believe that "most" premature newborns "need" resuscitation. Doctors like doing things that they believe help people. The drama that surrounds the birth of a premature infant encourages intervention. And to a man with a hammer, everything looks like a nail.

The logical next step is to prospectively study premature babies who do not get mask respiratory support immediately after birth. We might then better understand what proportion of premature babies born in the modern era "need" intervention and how soon after birth that might occur. That might allow us design studies where strategies for intervention could be meaningfully compared. While respiratory support with a face mask is the standard of care in the delivery room, non-invasive respiratory support is most commonly given to premature babies in the neonatal intensive care unit by the nasal route. Studies that compared face mask to single nasal prong did not show a difference in the rate of intubation in the delivery room[16] or in the first 24 h.[17] A study comparing the effect of supporting babies <28 weeks with a nasal interface compared to face mask on death or delivery room intubation is ongoing.[18] An issue that bedevils studies of delivery room interventions will continue apply – what is a clinically meaningful outcome? In Kuypers' study, half the babies who had a face mask applied stopped breathing for about 30 s. Does that really matter? The choice of outcome will be crucial, particularly in studies where it will be difficult or impossible to mask group assignment to clinicians with cognitive bias.

Perhaps the most reassuring finding of this study is that the majority (86%) of premature breathe spontaneously at birth. So keep calm. Don't panic. Hurry slowly. Breathe. Watch the babies breathing. And if they're not, entertain the possibility that the face mask you have applied might be the problem.

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Received 13 September 2019

http://dx.doi.org/10.1016/j.resuscitation.2019.09.017