Circuit for Bubble CPAP

Kaur, *et al*.(1) describe a simple and inexpensive bubble CPAP for use in resource poor settings. Bubble CPAP in its most basic form has been in use since early 1970s. We would like to draw the attention of the readers to certain important issues raised by this article. The simple circuit could do more harm than good if the baby is going to receive unhumidified and cold air. Addition of an effective humidifier would increase the cost ten fold. The use of humidifiers is not as simple as it may sound. Air at 37°C and 100% humidity carries 44mg/L of water. But once this heated and humidified air enters the tubing to be carried to the patient end, it condenses resulting in "rainout" and if this water trickles into the patient airway, it might result in airway collapse and pneumonia. Herein lies the importance of having a heating mechanism in the tubing to the patient end. If commercially available tubings are used, this would mean an additional cost of rupees 1200/-.

The authors have mentioned that CPAP can be delivered by nasal prongs. The system described and depicted in the figure may not be compatible with the commercially available binasal prongs as the figure shows only one tube connected to the interface. Under the discussion section, the authors have stated that endotracheal tube or a large bore suction catheter cut down to be used as a single prong CPAP is as comfortable as a more expensive nasal prongs. But the study quoted by the authors(2) has used a soft ET tube cut as a nasal prong inserted to a distance 2-3 cm instead of a nasopharyngeal prong. Hence the level of comfort of both these patient interfaces may not be directly comparable. Moreover, there is enough evidence to state that short binasal prongs are better than single, nasopharyngeal prong(3).

The oxygen saturation targets suggested by the authors (92-98%) are higher than the standard recommendations. Any saturation beyond 95% in preterm babies would significantly increase the risk of hyperoxia and attendant complications. The authors state that "in areas where saturation monitors are not available, bubbling CPAP would be safe". We think this statement sends a wrong message that saturation monitoring is not required during CPAP administration. On the contrary, saturation monitoring should be mandatory while using CPAP.

An indigenously developed low cost device is certainly welcome but not at the cost of compromised safety and potential harm.

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A Simple Circuit to Deliver Bubbling CPAP: Not So Simple!

We compliment Kaur, *et al*.(1) for bringing up the focus on the utility of CPAP in preterm neonates with respiratory distress. The indigenous CPAP circuit depicted in this article was first described by Gregory, *et al.*(2) and has been used all around the world including Indian neonatal units for more than three decades. However, while trying to bring down the costs of any equipment, compromising on the safety features can be counter-productive.

This circuit has its limitations. Application of CPAP to a neonate includes not only providing stable

pressure, but also warm (at 37ºC) and humidified (100% relative humidity) oxygen at desired FiO_2. This can not be achieved with this simple circuit. An efficient and effective humidifier costs at least Rs. 20,000. Also, if a heated wire is not present in the circuit, it leads to condensation, fluctuations in delivered pressure and increased risk of infection. Incompletely humidified or warmed gas leads to excessive excoriation of nostrils and nasopharynx.

Although FiO_2 has been calculated and expected values tabulated previously by others, as has been done by the authors of this paper, in real life, the measured FiO_2 is different from the calculated values. This is because the delivered FiO_2 depends on many other factors like pressure in the gas chambers, circuit compliance, precision of flow meter etc., apart from the relative air and oxygen flow rates. Hence, though one may manage without an expensive blender; in lieu, a FiO_2 monitor is a must and it costs between Rs. 15,000 to 25,000. We would disagree with the authors that bubbling CPAP can be safely used without having a pulse oximeter. The upper oxygen saturation limit in preterm babies should not be allowed to exceed 95% because of the potential risk of retinopathy of prematurity and hyperoxemia.

The first principle of any therapy has to be *Primum non nocere*. Therefore, one has to keep the limitations and potential dangers of this simple circuit described by Gregory in mind and strive to provide optimal CPAP even though at a higher cost. An efficient humidifier and a pulse oximeter have to be integral part of any CPAP system for neonates.

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Reply

We thank Murki and Sethuraman with their colleagues for their interest in our paper on bubbling CPAP. Both letters discuss variations of a theme and so we will respond to them together.

The first point made is that the system we describe is the same as that described by Gregory, *et al.* long back in 1971 and one which has now been discarded in favor of a CPAP apparatus that provides warmed, humidified oxygen and 'stable pressure'. Indeed the authors are right, that the system we describe is not new. We have been using it in our hospital for over 10 years now. When we started, we used it rather apologetically as a poor man's alternative, when more posh units were using the expensive CPAP machines giving 'stable pressure.' Then suddenly, America discovered 'bubbling CPAP' and the advantages that it brought. Instantly the old system became the state-of-the-art CPAP machine, vastly superior to the expensive system giving 'stable pressure'. We are no longer apologetic about using bubbling CPAP and that is the context in which we sent our paper for publication. The message is simple - the inexpensive devise is superior to 'stable pressure CPAP' and even people working in resource poor settings can use it to save lives.

The correspondents say we have advocated use of bubble CPAP without saturation monitoring. This is not correct. We have said that bubble CPAP with air is safe and saturation monitoring is not required. This is true and we stand by what we wrote.

The correspondents suggest that only humidifiers provided with heating coils in the tubing must be used. Voltaire has written of the 'best as the enemy of the good'- how by exalting only the 'best', we discourage other good solutions and lower the overall level of quality. Now that humidifiers and heating coils for the tubing are available, are we to say that doctors working in remote areas of India are not allowed to use oxygen from a cylinder unless they have all the equipment for providing it warmed and humidified at 37º C. In fact, even some of the older positive pressure ventilators we use in our unit do not have heating coils in the tubing but only