Correspondence

Measurement of oxygen consumption in infants

Sir,
The paper by Evans *et al.* (*Archives*, 1978, 53, 330) describing a simple method for measuring oxygen consumption contains inaccuracies I should like to correct.

The assertion that methods using a lower flow rate 'almost certainly result in CO₂ retention' is wrong. The method described by me (Smales, 1978) uses a flow rate of 1 l/min and by sampling continuously from the nares in a term infant we were unable to demonstrate any alteration in the CO₂ profile using the Edward's medi-shield medical mass spectrometer. At 500 ml/min, however, baseline shift was observed.

In addition when oxygen consumption was measured at various flow rates between 1 and 3 l/min no significant differences were observed. I would suggest that the reason for this is that when a constant bias flow is applied to the proximal channel, flow rates exceeding this may occur during expiration through the distal part of tubing. In the method described by Evans *et al.* the flow rate of mixed expiratory gases through the distal tubing is constant and must therefore be higher to avoid CO₂ retention.

Although they omitted my data from their list of comparative values of VO₂ in neonates, Evans *et al.* will find that there is also close agreement with previous workers.

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Reference

Smales, O. R. C. (1978). Simple method for measuring oxygen consumption in babies. *Archives of Disease in Childhood*, 53, 53-57.

Dr Evans and co-workers comment:

Dr Smales differs with us over our reason for using higher gas flows than he feels are necessary. It is our justification for this that he labels inaccurate. We firmly adhere to our belief that gas flows in excess of 1 l/min are mandatory to prevent rebreathing in the mature newborn who has a peak inspiratory flow rate of over 2 l/min, therefore gas flows less than this, for instance 1 l/min, will inevitably cause some rebreathing. This was predicted (Onchi *et al.*, 1957) and demonstrated experimentally (Willis *et al.*, 1975). Our experience leads us to the conclusion that to prevent CO₂ retention the gas flow has to be at least twice the minute volume. Figs 1 and 2 show CO₂ analysis in gas expired from the nostrils of a 2.5 kg newborn infant using a mass spectrometer (Centronic MGA 200). When the flow through the mask is 1 l/min, the inspired CO₂ concentration rises to between 1 and 2% and the ventilatory rate increases from 38 to 47/min (Fig. 1). When the flow is raised to 3.3 l/min (Fig. 2), there is still some rebreathing of the first breaths but this does not occur later. It is essential that CO₂ is not retained during the measurement of oxygen consumption as the increased carbon dioxide level causes a rise in ventilatory rate, increased work, and thereby a rise in oxygen consumption.

The relative patterns of gas flows in the limbs of the circuit are not relevant to the problem of rebreathing (Onchi *et al.*, 1957). The essential factor is the net gas flows through the mask. It is this which determines whether or not rebreathing will occur.

We are not able to account for Dr Smales's inability to demonstrate CO₂ retention on low gas flows. This is contrary to other reports (Onchi *et al.*, 1957; Willis *et al.*, 1975). We did not compare his results with ours because the populations studied were different. Dr Smales's

Fig. 1 CO₂ concentration in expired gases of a 2.5 kg newborn infant; flow rate 1.0 l/min.