- 2 Henderson, Y. *Adventures in Respiration. Modes of Asphyxiation and Methods of Resuscitation.* Williams & Wilkins: Baltimore, 1938.

REPLY

I would like to thank Dr. Parsloe for correcting my error. My source attributed this quotation to the British physiologist Samson Wright¹ who was known to use it frequently in his teaching and as the title of an essay project he assigned to medical students.² While Dr. Wright may have popularized this quotation, it is clear that F. Miescher was the original author.

As Dr. Parsloe's references indicate, the concept that CO₂ protects the oxygen supply arose from consideration of its physiological role in helping to regulate several fundamental processes required for oxygenation – including alveolar ventilation, cardiac output, regional circulation, and the oxygen saturation and desaturation of haemoglobin. It seemed to me that this concept is at least equally apt when applied to the monitoring role that CO₂ can play in indicating disturbances of oxygenation during anaesthesia. This capability of CO₂ can be readily appreciated by considering the series of metabolic, circulatory, ventilatory and equipment processes involved in both oxygen and CO₂ transport in anaesthetized patients, together with the manner in which CO₂ is commonly monitored (Figure).

Carbon dioxide is typically monitored by capnography at the airway opening – this being a distal or downstream site in the CO₂ transport chain. (In a somewhat analogous way, oxygen is monitored by oximetry at the level of the microvasculature – a relatively distal point in its conveyance chain.) Since the continuous delivery of CO₂ to the airway is completely dependent upon the moment to moment function of each component of the transport system upstream, the nature and size of the CO₂ signal at the airway opening responds rapidly to any disturbance of ventilation, circulation and/or metabolism that alters the transfer of CO₂ upstream. In addition, the airway CO₂ signal reacts to any reversal of CO₂ flow caused by re-breathing malfunctions of anaesthetic equipment. Since the delivery of oxygen to the tissues utilizes the same transport system (in reverse), the disturbances that alter CO₂ transfer or flow

and the resulting airway CO₂ signal can also act to impair oxygenation. In fact, these disturbances constitute the most important causes of tissue hypoxia during anaesthesia.³ By alerting the clinician about these problems, the airway CO₂ signal is ultimately protecting the oxygen supply.

Thus, in the context of anaesthesia, carbon dioxide can act to safeguard oxygenation in two related but different ways: (1) by helping to regulate the physiologic processes required for delivery of oxygen to the tissues (as it does elsewhere) and (2) by providing a signal which acts as a sensitive early warning indicator of disturbances of these oxygenating processes.³ For anaesthetists, the quotation of Miescher is doubly pertinent!

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REFERENCES

- 1 Campbell, EJM. *Not Always on the Level.* University Press, Cambridge 1988; 87.
- 2 Campbell, EJM. Personal communication.
- 3 Knill, RL. Practical CO₂ monitoring in anaesthesia. *Can J Anaesth* 1993; 40: Pt. 2, R40–R45.

Safety hazard – Sabex drug labels

To the Editor:

We would like to bring to your attention a safety hazard of which we have just become aware. Our institution recently changed suppliers of morphine and atropine to Sabex. They distribute both drugs in one mg glass vials. Unfortunately, Sabex markets both products with almost identical labels. The Figure illustrates some of the similarity. The label colours of both drugs have similar shades

FIGURE A depiction of the corporate system required for carbon dioxide and oxygen transport during anaesthesia, together with the sites at which CO₂ and O₂ transfer are monitored.

FIGURE