

normovolamischen schock in beziehung gesetzt zum kontinuierlich gemessenen art. und ven.  $PO_2$ , pH-werten und kardiozirkulatorischen parametern. Medical Doctoral Thesis at Ludwig-Maximilians Universität, Munich, West Germany, 1977.

- 11 Tremper KK, Waxman K, Shoemaker WC. Effects of hypoxia and shock on transcutaneous  $PO_2$  values in dogs. *Crit Care Med* 1979; 7: 526-31.
- 12 Rowe MI, Weinberg G. Transcutaneous oxygen monitoring in shock and resuscitation. *J Ped Surg* 1979; 14: 773-8.
- 13 Tremper KK, Waxman KS, Applebaum RA et al. Transcutaneous  $PO_2$  monitoring during sodium nitroprusside infusion. *Crit Care Med* 1985; 13: 65-7.
- 14 Tremper KK, Hufstедler SM, Zaccari J et al. Transcutaneous and liver surface  $PO_2$  during normotensive shock in dogs. *Anesth Analg* 1985; 64: 294.
- 15 Barker SJ, Tremper KK. Transcutaneous oxygen tension: a physiological variable for monitoring oxygenation. *J Clin Monitoring* 1985; 1: 130-4.

#### REPLY

The specific issue addressed in the Refresher Course was the potential value of various monitors in detecting hypoxaemia during clinical anaesthesia. It is clear that the transcutaneous oxygen tension ( $PtcO_2$ ) does not reflect absolute  $PaO_2$ , being anywhere from 30 to 130 per cent of  $PaO_2$  values. Notwithstanding this marked variability, it has been suggested that  $PtcO_2$  might be useful in detecting hypoxaemia by indicating  $PaO_2$  trends. In a limited study of anaesthetized adults, we observed that the  $PtcO_2$  did not consistently follow  $PaO_2$  changes. From a larger study of patients and a review of the literature, Dr. Tremper has apparently reached the opposite conclusion.

Dr. Tremper's assessment appears to have been based upon significant correlation coefficients between  $PtcO_2$  and  $PaO_2$  values at normal and high  $PaO_2$  levels. Ours was based upon the lack of reliability and the very long response times of  $PtcO_2$  in following induced reductions of  $PaO_2$ . The different conclusions appear related in the first place to differences in data analysis, and specifically to the use of the correlation coefficient in assessing consistency of trend detection. For example, in Figure 2 of Dr. Tremper's original report<sup>1</sup> it appears that  $PaO_2$  values measured every 15 minutes during the course of an anaesthetic increased or decreased ten different times. Since the  $PtcO_2$  correlated significantly with these  $PaO_2$  values, it was concluded that the  $PtcO_2$  "trended with the  $PaO_2$  values." However, the data presented in the Figure show clearly that with five of the ten changes in  $PaO_2$ , the  $PtcO_2$  moved in the opposite direction. These inappropriate shifts of  $PtcO_2$  cannot all be accounted for by changes in cardiovascular variables. Thus, a direct analysis of Dr. Tremper's data as well as our own, reveals that the

$PtcO_2$  does not consistently follow  $PaO_2$  trends. Furthermore, this analysis points out the danger of inferring consistency of  $PtcO_2$  performance on the basis of correlation coefficients alone.

Before one accepts the  $PtcO_2$  as an indicator of peripheral tissue oxygenation, it is important to remember that it is not a physiological oxygen tension but one which is induced artificially at the surface of the skin, and that it is critically dependent upon and influenced by the factors used to induce it. These include (1) local heating of the skin which vasodilates the circulation and shifts the oxyhaemoglobin dissociation curve to the right (thereby artificially increasing blood  $PO_2$ ) and (2) the addition of a considerable resistance to oxygen diffusion at the surface of the skin (thereby artificially increasing  $PO_2$  values in the skin). Any  $PtcO_2$  value represents a complicated and variable interaction between the effects of these inducing factors and the effects of the principal physiological influences on  $PtcO_2$ , i.e., the  $PaO_2$ , the cutaneous oxygen consumption and the rate of local cutaneous perfusion which is in itself affected by  $PaO_2$ . Hence, the varying and unpredictable relationships between  $PtcO_2$  and  $PaO_2$ . It seems to me that if  $PtcO_2$  is to become a meaningful indicator of tissue oxygenation and/or a reliable index of change of  $PaO_2$  or perfusion, some method will have to be found to control or independently assess the influence of the added variables.

For the moment, modern ear oximeters are far more direct, accurate, rapidly responsive and reliable detectors of hypoxaemia in anaesthetized adults.

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#### REFERENCE

- 1 Tremper KK, Shoemaker WC. Transcutaneous oxygen monitoring of critically ill adults, with and without low flow shock. *Crit Care Med* 1981; 9: 706-9.

## Recurrence of bronchial asthma after adrenalectomy for phaeochromocytoma

To the Editor:

Although it is well known that plasma epinephrine plays an important role in the relaxation of bronchial smooth muscles,<sup>1-3</sup> there has been only one case report of asthmatic attacks recurring after removal of a phaeochromocytoma in an asthmatic.<sup>4</sup> We wish to report such an episode which occurred