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## Methylene Blue and Pulse Oximetry Readings: Spuriouser and Spuriouser!

*To the Editor:*—In their discussion of the effect of methylene blue on pulse oximetry readings, Kessler *et al.*[1] state that, "Should any doubt exist, an arterial blood sample should be obtained to confirm $Pa_{O_2}$ and hemoglobin saturation." Such a sample will only facilitate an accurate estimate of $Pa_{O_2}$ and a *calculated* saturation (based on the oxygen-hemoglobin dissociation curve). Hemoglobin saturation ($SaO_2$) is normally measured using a laboratory co-oximeter, such as the IL 282 (Instrumentation Laboratory, Lexington, MA), and these devices are also subject to error in the presence of methylene blue, tending to underestimate oxyhemoglobin and overestimate methemoglobin (MetHb).* No figures are available to quantitate this interference caused by blue dyes.*

Where a suspiciously high reading for MetHb is obtained from the co-oximeter, the data may be verified by adding a reducing agent (sodium dithionite) to the blood sample and reanalyzing. If the original results are valid, %MetHb will be reduced and read ±1.0% on the IL 282. If the results are not valid, as might be the case in the presence of a methylene blue, the %MetHb will remain unchanged or will not be reduced to less than 1.0%.†

Thus, while anesthesiologists should be aware of spurious pulse oximeter desaturation in the presence of blue dyes, they should also be aware that the usual methods for confirming $SaO_2$ may also produce spurious results.

* Operator's Manual. IL 282 CO-Oximeter. Instrumentation Laboratory, Lexington, MA 02173, p. 1.2., 1978.

† The 282 CO-Oximeter Abnormal Data Interpretation Guide. Instrumentation Laboratory, Lexington, MA 02173, 1979.

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*In Reply:*—Dr. Eisenkraft points out that a sample of blood containing methylene blue (absorption peak of 668 nm) will indicate the presence of desaturation when that sample is injected into a laboratory co-oximeter (IL 282) as it similarly causes the appearance of a desaturation with the pulse oximeter.[1]

It should also be noted that a laboratory co-oximeter differs significantly from a pulse oximeter in the number of wavelengths used in the assay and the complexity of the algorithm for calculating per cent oxygen saturation. Also, a different model co-oximeter might assay and calculate per cent oxygen saturation in a different way.

The IL 282 uses four wavelengths in its assay (535, 585, 594, and 626 nm). The instrument used at my institution (Radiometer OSM-3) samples six wavelengths of light (535, 560, 577, 622, 636, and 670 nm), and assigns a relative contribution (or factors out an interference) at each wavelength to calculate values for oxyhemoglobin, methemoglobin, carboxyhemoglobin, and total hemoglobin). The OSM-3, according to the manual, gives a falsely *elevated* per cent oxygen saturation and a falsely decreased per cent methemoglobin in the presence of 60 mg/liter of methylene blue.

I have recently used the OSM-3 to sample blood containing methylene blue at a higher concentration than referenced in the manual—600 mg/liter. This resulted in a 10% decrease in oxygen saturation, a 30% decrease in total hemoglobin content, an indication of the presence of sulfhemoglobin, a turbidity error, and no methemoglobin. The same sample containing indigo carmine (absorption peak approximately 610 nm)[2] produced a 22% decrease in oxygen saturation and showed a methemoglobin content of 24%. Fluorescein dye produced no change in oxygen saturation, but showed the presence of 9.6% carboxyhemoglobin.

Therefore, the suspected presence of an interfering substance in a blood sample should alert the clinician to

a possible spurious result. The operating manual of the co-oximeter will usually have a list of known interfering substances and of the behavior of the co-oximeter in their presence.

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## Does Epidural Anesthesia Improve Ventricular Function?

*To the Editor:*—In their recent article,[1] Baron *et al.* conclude that ". . . lumbar epidural anesthesia improves left ventricular global and regional function in patients with a history of mild angina as long as volume loading is limited." However, do the presented data support their conclusion?

Following institution of epidural anesthesia, cardiac index (CI) and stroke volume index (SI) decreased by approximately 20%. The peak systolic pressure-end systolic volume (PSP/ESV) ratio, used as an indicator of myocardial contractility, remained unchanged. The only parameter of global left ventricular (LV) function that "improved" was LV ejection fraction (LVEF).

However, is radionuclide angiography really sensitive enought to reliably diagnose a change from 54 ± 2 to 59 ± 3? Even if it were, how physiologically and clinically relevant is such a change when end diastolic volume, CI, and SI decrease simultaneously by approximately 20%, the PSP/ESV ratio remains unchanged, and LV afterload tends to decrease?

Following volume loading, mean arterial pressure, CI, and SI all improved, and the PSP/ESV ratio remained unchanged. The only parameter which "worsened" was LVEF. But, again, the decrease was small, and it occurred in the presence of changing loading conditions.

As far as regional function is concerned, epidural anesthesia reduced the number of hypokinetic sectors from 19 out of 120 sectors analyzed to five out of 120. Upon volume loading, the number of hypokinetic sectors increased to 11. Although there is a significant difference between the initial 19 out of 120 and the five out of 120, there is no significant difference between five out of 120 and 11 out of 120 ($P > 0.15$), and between 19 out of 120 (*i.e.*, control) and 11 out of 120 (*i.e.*, following volume loading; $P > 0.15$).

We agree with the authors that ". . . lumbar epidural anesthesia appears to be a safe anesthetic method" (last paragraph). However, we would not interpret the data as showing that global LV function improved following induction of epidural anesthesia, and that volume loading had adverse effects on global or regional LV function. We would rather interpret the data as showing that cardiac function (as judged by the PSP/ESV ratio) remained unchanged throughout, that changes in LVEF reflect changes in loading conditions, and that volume loading restored coronary perfusion pressure and global cardiac performance (as judged by CI and SI) without worsening regional myocardial performance.

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