Routine Oximetry
A Fifth Vital Sign?

Often, advances in medical technology become available on a widespread basis before a controlled scientific experience has accumulated to carefully delineate the indications, uses, and pitfalls of such technology. I feel this certainly is the case with pulse oximetry and this issue is partially addressed by the data of Loggan, Kerby and Pingleton (see page 242). The accuracy, simplicity and usefulness of pulse oximetry is well known and accepted by most pulmonologists today. The main issue now surfacing is its appropriate use and application. I feel there are basically two issues to be addressed: 1) appropriate scientific application and efficiency, and 2) as always, the medical economics.

When one proposes a “new procedure or test” as routine, one would like to justify it by showing an efficient scientific value vs the additional effort or cost.

Basic Medical Economics and Systems Efficiency

Today, most pulmonary specialists, whether in private practice, large clinics or hospital-based medical centers, have ready access to accurate pulse oximeters. These oximeters are usually available on a “continuous standby basis” for selected patients. In such settings they are essentially as available as an ophthalmoscope, automated blood pressure cuff, etc. Most often, nurses, technicians, physicians’ assistants, etc are the personnel measuring the patients’ saturation with this equipment. I feel the time has come in some settings where one can easily justify the routine use of this high tech equipment as a simple, safe non-additional cost procedure. That is, the available oximetry could be used in all pulmonary outpatients at no significant increased costs. Currently, an accurate pulse rate is obtained simultaneously with most oximeters. Probably before long the patient’s blood pressure, the respiratory rate, and even temperature will be obtained rapidly, accurately and simultaneously, with a “polyvitalsignometer.” Let’s include oxygen saturation as a fifth vital sign and have a pentavitalsignometer. In such a routine setting, an additional, separate charge would not be justified, and the total charge should be similar now to the charge we submit for taking the blood pressure, and/or other vital signs.

Why Have the Data?

In the hospital-based pulmonary clinic which I attend, the availability and simplicity of routine oximetry is much greater than the spirometry (see Loggan’s protocol) and I certainly would recommend employment of routine oximetry before routine spirometry. In my experience, routine oximetry is helpful for carefully monitoring all patients who are receiving continuous supplemental oxygen therapy and also in those patients with moderate to severe pulmonary disease who have “borderline” hypoxemia most of the time. Its routine availability will help pick up significant changes such as a drop in oxygen saturation of more than 5 percent—for example, a drop from 96 to 91 percent is often very significant. (Note the study reported by Loggan et al did not address such changes.) For example, a change in blood pressure from 130/80 to 100/60 mm Hg, although the latter blood pressure in and of itself may be normal, certainly would be very significant.

In summary, the technology for routine oximetric measurement is available and probably underutilized in most settings. I feel the time has come for it to be used in selected populations (all patients receiving supplemental oxygen therapy, all patients with moderate to severe lung disease, etc) routinely with a charge being similar to what one charges for taking blood pressure and temperature. If one looks at a patient’s blood oxygenation saturation with the perspective of a simple cost-efficient vital sign, I do not feel the argument of routine vs selective would really be significant. The data obtained, however, might be very significant for the correct management of individual hypoxemic patients.

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Predicting Weaning Outcome

Mechanical ventilation is associated with a host of complications and, thus, should be discontinued as soon as the patient is able to sustain spontaneous ventilation. Premature discontinuation of ventilatory support, however, may lead to severe respiratory distress or respiratory arrest. Thus, a means of predicting weaning outcome is desirable. While an experienced physician may be able to form a gestalt as to the likelihood of successful weaning in an individual patient, it is preferable to have quantifiable indices that can be widely applied. A number of weaning parameters are commonly employed but several studies, including that by Fiastor et al in this issue (see page 232), have shown that these “predictors” are frequently falsely-positive and falsely-negative.

What accounts for the poor performance of the conventional predictors? At least three factors may play a role. One is the type of patient in the more recent reports may differ from those in the original studies from which the criteria were derived. Second, the method of making the measurements may differ.
between the studies. Third, the conventional indices may not reflect the true determinants of weaning outcome.

Consequently, there is a need for better predictive indices. Fiaastro et al recommend work of breathing as a good predictor of weaning outcome. However, work of breathing involves relatively invasive and complex measurements, and it has never been accepted as a practical clinical technique. Although not discussed in the article, it is apparent that the initial respiratory rate of the ventilator-dependent patients was significantly higher than in the patients who were rapidly weaned, 32.4 ± 3.6 (SE) and 18.8 ± 1.5 breaths/min, respectively (p<0.005). Other reports have also suggested that respiratory rate may be useful in distinguishing ventilator-dependent patients from those who can be easily weaned. If true, this suggests that more attention needs to be paid to one of the simplest and most elementary clinical signs, rather than obtaining complex measurements. However, no single index is likely to be successful in predicting weaning outcome, and an algorithm of several indices may have greater predictive power. Respiratory muscle fatigue is commonly considered to be an important cause of weaning failure, but despite an enormous growth of research on this subject, a useful clinical index of fatigue remains elusive. Abdominal paradox (inward motion during inspiration) has been considered a valid index of fatigue, but recent evidence suggests that it is probably more often related to respiratory load, rather than fatigue per se. In addition, abdominal paradox does not appear to be useful in predicting the outcome of a weaning trial. However, the overall degree of asynchronous (time lag between movement of the ribcage and abdomen) and paradoxic motion of the ribcage and the abdomen, and the degree of breath-to-breath variability in the contribution of the ribcage and abdomen to tidal volume may be useful in predicting weaning outcome, although these measurements require relatively sophisticated techniques. Other indices have been proposed, such as inspiratory muscle effort, but have yet to be tested. Certainly, more prospective studies of new predictive indices or algorithms of weaning outcome are needed.

In devising new predictors, it is important to consider the true determinants of weaning outcome. Two factors appear to be of predominant importance in the serial investigations of Fiaastro et al: resolution of the illness that precipitated the need for mechanical ventilation, and the level of respiratory work during spontaneous breathing. Although respiratory muscle fatigue is commonly considered to be an important additional cause of failure to wean from mechanical ventilation, very few clinical data have been obtained to support this viewpoint. Instead, the primary determinant of ventilatory failure may be abnormalities in pulmonary mechanics causing an increased work of breathing, with fatigue playing a secondary role.

In conclusion, the study of Fiaastro et al in this issue of Chest has three important messages: (1) conventional predictors of weaning outcome are frequently inaccurate; (2) resolution of the precipitating illness is the major clinical factor determining the time of successful weaning; and (3) the major physiologic determinant of weaning outcome is the level of respiratory work.

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REFERENCES

Routine Screening for Tuberculosis on Hospital Admission

There is no finality to our understanding in the field of human endeavor. No matter how certain we are that conclusions are correct, circumstances just do not stay the same. Dealing with tuberculosis is an example. The cause of tuberculosis has been known for more than 100 years. We understand its transmission, pathogenesis, prevention and treatment in the greatest detail. We have analyzed, and as a consequence, changed our approach to controlling the disease. We have been concerned about cost effectiveness and greater benefits for less risk which is reflected in some of those changes. We have pointed with satisfaction to the "predictable" decline in the case rate in the United States.