WHY MEASURE THE EXPIRED VENTILATION?

If a rescuer is following the latest AHA Guidelines with respect to respiration rate why is it still important to measure the *expired* tidal and minute volumes?

Assume a rescuer is attempting to resuscitate a 180 pound man, and in keeping with the new AHA Guidelines, is attempting to administer 10 breaths per minute of 500 ml. each (for a minute volume of 5 liters). Now let us also assume that, unknown to the rescuer, the patient is actually getting less ventilation than the rescuer intended. This may be due to any of a number of reasons such as; inadequate compression of the bag, inadequate frequency of compression, leakage at any of several locations, a malfunction within the BVM, etc. etc.

As an example, let us assume undetected leakage around the mask of 200 ml. per breath (which can easily occur and often does). The minute volume actually received by the patient is now 3 liters, or 60% of what was intended. This may not sound too catastrophic, but let us consider it a little more carefully:

To calculate the *effective* (alveolar) ventilation we must take into account the patient's anatomical dead space, which for a 180 pound man may be about 180 ml. To this add another 20 ml. for external system dead volume, for a total dead volume of 200 ml. Therefore, for a supplied minute volume of 5 liters, the *effective ventilation* comparison is:

Without mask leakage; 10 (500 –200) = 3 liters/min. alveolar ventilation

With mask leakage; 10 (500 -200) -200 = 1 liter/min. alveolar ventilation

The patient is therefore getting only *one third* of the alveolar ventilation that the AHA Guidelines intended, which makes it a much more serious, and potentially catastrophic, problem.

Note that the dead space in the mask was not included in the above calculation because the mask leakage assumed would mitigate its effect. But, if we assume some other reason for a shortfall in the supplied ventilation, allowance must also be made for the mask dead space, which may be considerable, and would further decrease the effective ventilation.

And this does not tell the whole story. With reference to the example cited above, the shortfall in *effective ventilation* may even be considerably worse than calculated if the patient has significant *alveolar* dead space (which together with the *anatomical* dead space forms the *physiologic* dead space). The *effective* portion of the supplied ventilation, in terms of oxygenating the patient's blood, would then be still further decreased.

And, if the patient's blood is not adequately oxygenated, all other interventions, no matter how skillfully performed, will not save the patient.

However, if the expired tidal volume *is* measured, and falls short of what is intended, and what a trained rescuer thinks the patient should be exhaling based on their manipulation of the bag, it should prompt the rescuer to check for mask leakage (or, if the patient is intubated, to see if the ET moved, or if there is leakage around the cuff). Or, to investigate whether, perhaps, the short fall is due to some malfunction within the manual resuscitation device.

Continuous measurement of the expired ventilation parameters can therefore help trained rescuers rectify, and/or compensate for serious problems that might not be readily apparent or intuitively obvious.

The Exhalometer, a small and inexpensive FDA cleared instrument, that measures each expired tidal volume, the expired minute volume and the respiration rate, provides the information trained rescuers require to optimize ventilation. With the advent of the Exhalometer, uncontrolled ventilation need no longer be accepted as a standard-of-care.

So, in answer to the introductory question:

If ***the expired ventilation is not measured commonly encountered critical problems can easily go unnoticed and uncorrected resulting in a poor patient outcome***.

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