



Critical Care Therapy and Respiratory Care Section

Category:	Clinical
Section:	Clinical Monitoring
Title:	Deadspace Ventilation
Policy #:	05
Revised:	04/00

1.0 DESCRIPTION

1.1 Definition: Total ventilation is composed of two parts: gas that exchanges with pulmonary blood (alveolar ventilation) and gas that does not exchange with pulmonary blood (deadspace ventilation). The clinical significance of deadspace ventilation is the energy expended to move gas that has no physiologic advantage. If the deadspace ventilation is significant, a tremendous amount of energy must be expended to move additional gas so that normal alveolar ventilation can be maintained. A co-equal factor is the efficiency of pulmonary blood flow. Inadequate pulmonary blood flow will result in increased deadspace ventilation, because there is inadequate blood flow through the lungs to exchange with the gas (ventilation in excess of perfusion).

Deadspace ventilation (VD/VT) may be measured in mechanically ventilated patients as a means to assess the severity of gas exchange impairment and the readiness to wean. The VD/VT ratio is typically increased during mechanical ventilation and is considered normal up to 0.50. A VD/VT ratio less than 0.60 usually does not represent pulmonary pathology of sufficient magnitude to interfere with spontaneous ventilation. A VD/VT ratio of 0.60 to 0.80 represents significant disease and frequently interferes with the ability to maintain prolonged spontaneous ventilation.

1.2 Indications:

- 1.2.1 The measurement of deadspace ventilation may be indicated to assess the ability to maintain adequate spontaneous ventilation in mechanically ventilated patients, particularly those who are difficult to wean.
- 1.2.2 To monitor and to differentiate shunt-producing diseases from deadspace-producing diseases. Increased deadspace occurs in:
 - 1.2.2.1 Pulmonary embolism

- 1.2.2.2 Obstruction of regional vessels by masses
- 1.2.2.3 Emphysema
- 1.2.2.4 Pulmonary hypertension
- 1.2.2.5 Overdistention of alveoli

1.3 Precautions: The patient should be stable, quiet, and in a steady state condition at the time that the study is performed.

2.0 EQUIPMENT

- 2.1 Sixty liter Douglas sample bag
- 2.2 60 ml gas sampling syringe
- 2.3 Arterial blood gas syringe and supplies
- 2.4 Adapters to connect the external exhalation port of the ventilator to the Douglas Bag

3.0 PROCEDURE

- 3.1 Wash hands and collect all equipment and supplies.
- 3.2 Explain the procedure to the patient.
- 3.3 Connect the Douglas bag apparatus to the ventilator exhalation port. Position the valve on the Douglas bag so that there is a free flow of gas from the ventilator to the bag, and no gas may escape to the atmosphere.
- 3.4 Collect the exhaled gas for approximately two minutes and then expel as much of this as possible from the bag. This will wash out any previous sample remaining in the bag.
- 3.5 Reconnect the Douglas bag to the ventilator and begin collecting the sample gas. After 1.5 minutes, obtain simultaneous samples of arterial blood for blood gas analysis and exhaled gas. The sample of exhaled gas taken from the Douglas bag will allow for measurement of the partial pressure of expired CO₂ (P_ECO₂):
 - 3.5.1 For the exhaled gas, draw a 60 ml sample through the stopcock and sampling line on the Douglas bag and evacuate the gas sampling syringe through the stopcock maintaining a closed system. Repeat this process. Obtain a third sample to be analyzed. Take special care not to contaminate the gas sample with room air.
 - 3.5.2 Obtain an arterial sample in a heparinized syringe.

3.6 Analyze both samples using a blood gas analyzer. Analysis of the exhaled gas sample requires a procedure different from routine blood gas analysis.

3.6.1 Exhaled gas cannot be analyzed via the i-STAT. Samples must be hand carried to Chemistry lab for analysis on their blood gas analyzer.

3.7 Calculate the deadspace-to-tidal volume ratio (VD/VT) of the patient using the following formula:

$$VD/VT = \frac{PaCO_2 - P_E CO_2}{PaCO_2}$$

4.0 POST PROCEDURE

4.1 Remove all deadspace measurement supplies and equipment from the bedside when finished. Clean any soiling that may have occurred to the apparatus using alcohol or any other approved disinfectant.

4.2 Document the VD/VT ratio on the patient's bedside flowsheet and on the CCTRCS Patient Daily Sheet. Inform the medical team of the results.

5.0 REFERENCES

5.1 Oakes D. Clinical practitioners pocket guide to respiratory care. Old Town, ME: Health Educator Publications, Inc., 1988.

5.2 Barnes TA, ed. Respiratory care practice. Chicago: Yearbook Medical Publishers, Inc., 1988.

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