I. Description

Describes apnea testing as performed by Respiratory Therapists

Note: According to a report of the Quality Standards Subcommittee of the American Academy of Neurology, apnea is one of three cardinal findings in brain death (AAN Practice Parameters for Determining Brain Death, Neurology 1995;45;1012-1014). The other two are coma or unresponsiveness and absence of brainstem reflexes.

Note: This is further supported by Section 90-323 of the North Carolina General Statutes, which defines brain death as the irreversible cessation of total brain function, including the brain stem.

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II. Rationale

To safely determine, in patients with severe cortical injury and possible brain death, whether any respiratory center sensitivity to carbon dioxide exists.

Oxygenation during the test is accomplished by means of diffusion oxygenation since the patient remains connected to a source of 100% oxygen.

III. Policy/Procedure

A. Policy

The Respiratory Care Department will carry out the apnea test procedure. There must be a written physician’s order for the test. The order will clearly state that an apnea test is to be performed. The length of time the test is to be conducted must be stated. An order similar to “take patient off ventilator for 3 minutes” is not adequate.
B. Procedure

When the Respiratory Care Department is requested to perform an apnea test for the purpose of determining brain stem function, the therapist will contact the ordering physician and inform him/her of our procedure and methods. A physician must remain in attendance during the procedure.

**WARNING:** Terminate the test immediately if respiratory movements are observed. For adults (18 years and older) the test will be aborted if SBP < 90 mm Hg and refractory to vasopressors, oxygen saturation < 80% for at least 30 seconds, or unstable arrhythmia. For children (17 years and younger) the test will be aborted if there is relative hypotension refractory to vasopressors, a relative decrease in oxygen saturation, or an unstable arrhythmia as determined by the physician overseeing the apnea test.

**WARNING:** Do not perform this test by yourself if you have never performed it before. Always have an experienced respiratory therapist with you if you have not done this before.

1. Supplies Needed:
   a. Oxygen flow meter
   b. 6 foot oxygen tubing with (“fits all” connector on one end)
   c. T-tube
   d. 15 inch corrugated aerosol tubing
   e. Spring-loaded PEEP valve (optional)

2. Confirm that a clear physician’s order has been written in the patient’s medical record before proceeding. Assure that the patient meets the following criteria for the study:

   Adults (18 years and older)
   - Oxygen saturation ≥ 90% after pre-oxygenation with 100% FIO2 for 15 minutes
   - SBP ≥ 100 mm Hg
   - Patient has not recently received sedative and/or paralytic medications
   - Temperature ≥ 35 degrees Celsius

   Children (17 years and younger)
   - No relative hypoxemia
   - No relative hypotension
   - Patient has not recently received sedative and/or paralytic medications
   - Temperature ≥ 35 degrees Celsius
3. Check the patient’s ID band and verify the patient’s name.

4. Hyperoxygenate the patient with 100% oxygen for 10-15 minutes. (Preoxygenation is necessary for safety and in order to completely denitrogenate the patient).

5. Perform an arterial blood gas analysis to obtain the patient's initial arterial PaCO2 prior to initiating the apnea test. It is recommended that the initial PaCO2 be in the normal range of 35 – 45 mm Hg, however there are incidences when this is not feasible or safe and initiating an apnea test in this case will be at the discretion of the physician. Estimate with the initial ABG the time required to reach an apneic PaCO2 of at least 60 mm Hg and ≥ 20 mm Hg above the initial PaCO2.

- In adolescents and adults, the PaCO2 will rise approximately 4-5 mm Hg in the first minute and approximately 3-4 mm Hg for each consecutive minute.

- In pediatric patients, the rate of rise in PaCO2 is higher, and probably attributable to the higher rates of metabolism (8.3 mmHg after the first minute and 4 mmHg per minute thereafter).

### Table 1: Examples for Adults

<table>
<thead>
<tr>
<th>Initial PaCO2</th>
<th>Minutes to PaCO2 ≥ 60 and ≥ 20 from baseline</th>
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<tr>
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</tbody>
</table>

**Note:** Infants, young children, and adults with high metabolic rates use the following formula:

$$\text{Number of minutes off ventilator} = \frac{(\text{Target PaCO2} - \text{initial PaCO2}) \times \text{wt in kg}}{150}$$
6. If a cuffed intra-tracheal tube is present, ascertain that the cuff is sufficiently inflated and that there is not a leak for the duration of the test.

7. Assemble the T-tube oxygenation device by attaching the fits all end of a standard 6 foot oxygen tubing to one side of a standard aerosol T-tube and attach a 15 inch corrugated aerosol tubing to the opposite side in order to create a reservoir as depicted in figure 1.

8. If PEEP is being used, it may be continued during the apnea test at the discretion of the physician. Attach a spring-loaded PEEP valve, preset to the appropriate value, to the end of the 15-inch reservoir tubing as depicted in figure 2.

9. To start the apnea test, a physician involved in determining brain death must be present. Disconnect the patient from the ventilator and quickly connect the T-tube oxygenation device with oxygen flowing at 10 L/min for adults, 5L/min for children and 2 L/min for neonates. Expose the patient’s chest and abdomen for observation. Note the time, and begin timing the test.

10. At the conclusion of the apneic period and prior to resuming mechanical ventilation, an arterial blood gas should be drawn. Please be prepared to do this at the appropriate time – ask Nursing staff for assistance, if needed.
11. At the end of the prescribed period, return the patient to the previously established FI02, ventilator rate and alarm settings.

12. Chart a progress note that provides the following information:
   - Date
   - Time of test
   - Note that an Apnea Test was performed for ____ minutes on an FI02 of 100%
   - Pre and post-test pH, PaC02 and Pa02
   - Any evidence of active inspiratory effort at any time during the test.
   - Note if the test was discontinued prematurely, details should be noted.

13. Test Results:
   - Apnea Confirmed: Respiratory movements are absent and the PaC02 is ≥ 60 mm Hg and the PaC02 has increased by at least 20 mm Hg above the initial value. The physician needs to report that the apnea test result supports the diagnosis of brain death.
   - Apnea Not Confirmed: Respiratory movements confirmed. Chart the names of the witnesses, including the physician. The physician needs to report that the apnea test result does not support a diagnosis of brain death.
   - Apnea Unable to be Confirmed, Indeterminate Test: If the apnea test was discontinued prematurely, an ABG should be done immediately and the patient will be placed back on the ventilator pending the ABG results. If the PaC02 ≥ 60 mm Hg and the PaC02 is ≥ 20 mm Hg above the baseline, the criteria for confirming apnea have been met. If these criteria have not been met, then the test results are considered to be indeterminate, and the apnea test may be repeated after one hour.

IV. Original Policy Date and Revisions