



**POLICY:  
BRAIN DEATH IN ADULTS 18 YEARS OF AGE OR  
GREATER**

**ATTACHMENT A:  
APNEA TEST PROTOCOL – ADULTS 18 YEARS OF AGE OR  
GREATER**

**I. OBJECTIVES**

A. The purpose of this policy is to state a uniform process for the determination of apnea as part of the declaration of brain death in patients within the University of Maryland Medical Center (UMMC).

**II. INDICATIONS FOR USE**

A. This policy applies to all patients who are admitted to any inpatient unit or emergency department of UMMC. Non urgent procedure and do not use iSTAT.

**III. RESPONSIBILITY**

A. It shall be the responsibility of all physicians who have attending privileges to comply with the provisions of this policy in the care of individuals admitted to an inpatient unit or emergency department of UMMC.

B. Conducting an apnea test requires continual physician and respiratory therapy presence. The nurse will remain immediately available to the patient in the instance that decompensation were to arise.

**IV. PROCEDURE**

A. A physician will write an order for an apnea test and the respiratory therapist and nurse will be informed.

**B. Pre-Test Preparation**

1. Pre-test pH and PaCO<sub>2</sub> must be normalized to pH = 7.32 to 7.45 and PaCO<sub>2</sub> = 35 to 45 mmHg. If unable to normalize PaCO<sub>2</sub>, consider ancillary testing.
2. Pre-oxygenate for fifteen (15) minutes with 100% O<sub>2</sub>.
3. Obtain arterial blood gas to document pre-test pH and PaCO<sub>2</sub>
4. Adjust ventilator settings to achieve a pre-test pH = 7.32 to 7.45 and PaCO<sub>2</sub> = 35 to 45 mmHg RP001.
5. Repeat arterial blood gas as needed.

**C. Apnea Test Selection**

Select the apnea test method by assessing the patient's tolerance for removal from mechanical ventilation.

1. Conventional Method Procedure
  - a) Disconnect the patient from mechanical ventilation and administer oxygen thru a #10 french pediatric suction catheter, which should be placed at the level of the carina at 1- 4L/min (tape is placed over thumb port), or T piece as required to maintain baseline SaO<sub>2</sub>.
  - b) Reconnect the patient to mechanical ventilation immediately if any of the following occur:
    - (1) respiratory effort
    - (2) oxygen desaturation
    - (3) hypotension
    - (4) arrhythmias
  - c) After 10 minutes, draw an arterial blood gas.
  - d) The apnea test is considered positive and consistent with absence of brain stem activity if:  
The change in PaCO<sub>2</sub> is greater than or equal to 20 mmHg from pre-test PaCO<sub>2</sub> or PaCO<sub>2</sub> >60 mmHg  
AND
  - e) There is no evidence of ventilatory effect.
  - f) An ETCO<sub>2</sub> monitor may be utilized during the test to detect respiratory effort that may be missed by visual observation.
2. Carbogen Method Criteria should be selected if the patient meets any of the following criteria:
  - a) Baseline SpO<sub>2</sub> < 95% or < 100% after 15 minutes of pre-oxygenation
  - b) High-dose pressors (dopamine, levophed > 10 mcg/min) or multiple pressors
  - c) Severe bilateral pulmonary disease on radiograph
  - d) Physician discretion
3. Carbogen Method Procedure
  - a) The respiratory therapist RP001 will:
  - b) Connect the Carbogen (97% O<sub>2</sub>/3% CO<sub>2</sub>) cylinder to the high pressure line.
  - c) Deactivate back-up ventilation/apnea ventilation



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- d) Set the ventilator settings appropriately and the rate turned down to 2 breath(s) / minute
  - e) Adjust alarms appropriately
  - f) Assure that EtCO<sub>2</sub> is connected and properly functioning
  - g) ETCO<sub>2</sub> monitoring is utilized during the test to detect respiratory effort and to predict the end apnea PaCO<sub>2</sub> and pH.
4. Carbogen Method Calculation
- The necessary change in PaCO<sub>2</sub> for the Carbogen Method is determined by the required increase in PaCO<sub>2</sub> to reach a pH of 7.20 by the following formula:
- a) Necessary change in PaCO<sub>2</sub> = pH range (7.32 to 7.45) – 7.20 / 0.006.
  - b) Assuming that pH decreases by 0.006 with every 1 mmHg increase in PaCO<sub>2</sub>, this determines the required increase in PaCO<sub>2</sub> to reach a pH of 7.20.
  - c) Adding the necessary change in the PaCO<sub>2</sub> to the patient's pre apnea EtCO<sub>2</sub> determines the target EtCO<sub>2</sub> to be achieved.
  - d) Example:
    - (1) If initial pH = 7.40
    - (2) Necessary change in PaCO<sub>2</sub> = (7.40 – 7.20) / 0.006 = 33.3 mmHg
    - (3) And pre apnea EtCO<sub>2</sub> = 40
    - (4) Target EtCO<sub>2</sub> = 33.3 + 40 = 73.3
  - e) The ventilator flow waveforms and EtCO<sub>2</sub> are continuously monitored for spontaneous ventilatory effort.
5. Once the target EtCO<sub>2</sub> is reached, an arterial blood gas is drawn to confirm an adequate increase in PaCO<sub>2</sub> was achieved.

**ALL APNEA TESTS**

6. Discontinue apnea testing immediately if any of the following occur:
- a) respiratory effort
  - b) oxygen desaturation
  - c) hypotension
  - d) arrhythmias
7. The apnea test is considered positive and consistent with absence of brain stem activity if:
- a) The change in PaCO<sub>2</sub> is greater than or equal to 20 mmHg from pre-test PaCO<sub>2</sub>; or
  - b) The end apnea PaCO<sub>2</sub> is greater than or equal to 60 mmHg; AND
  - c) There is no evidence of ventilatory effect.
8. The Attending physician documents results on the Brain Death Evaluation form in the progress notes.