eISSN 2255-0569

CASE REPORT

Barotrauma during apnea testing for brain death. Barotrauma and apnea testing

Barotrauma durante la prueba de apnea para muerte cerebral. Pruebas de barotrauma y apnea

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Received: 22 - VIII - 2022
Accepted: 29 - VIII - 2022

doi: 10.3306/AJHS.2022.37.05.169

Abstract

The apnea test is used for the diagnosis of brain death. Various complications have been reported to have developed during the apnea test.

A 44-year-old woman was hospitalized in the intensive care unit due to unconsciousness due to a posterior inferior carotid artery aneurysm. On the forty-ninth day of her hospitalization in the intensive care unit, the patient had no motor response and all brain stem reflexes were negative. Brain death was considered in the patient, but subcutaneous emphysema and bilateral pneumothorax developed within minutes during the apnea test. The patient underwent bilateral tube thoracostomy. The patient could not be diagnosed with brain death and died on the fiftieth day of her hospitalization.

This report emphasizes that multiple complications can be observed during the apnea test and underlying mechanisms and therapeutic approaches are discussed.

Key words: Brain death, apnea test, barotrauma.

Resumen

La prueba de apnea se utiliza para el diagnóstico de muerte cerebral. Se ha informado que se han desarrollado varias complicaciones durante la prueba de apnea.

Una mujer de 44 años fue hospitalizada en la unidad de cuidados intensivos por pérdida del conocimiento debido a un aneurisma de la arteria carótida inferior posterior. Al cuadragésimo noveno día de su hospitalización en la unidad de cuidados intensivos, la paciente no tenía respuesta motora y todos los reflejos del tronco encefálico eran negativos. Se consideró muerte cerebral en el paciente, pero se desarrollaron enfisema subcutáneo y neumotórax bilateral en cuestión de minutos durante la prueba de apnea. El paciente se sometió a una toracostomía con tubo bilateral. La paciente no pudo ser diagnosticada de muerte encefálica y falleció al quincuagésimo día de su hospitalización.

Este informe enfatiza que se pueden observar múltiples complicaciones durante la prueba de apnea y se discuten los mecanismos subyacentes y los enfoques terapéuticos.

Palabras clave: Muerte encefálica, prueba de apnea, barotrauma.

Introduction

Brain death (BD) is the event of irreversible damage to all brain functions, including the brain stem[1]. The guidelines of the American Academy of Neurology are often used for for determining brain death[2]. During the apnea test, the patient is temporarily disconnected from the ventilator and PaCO2 levels are allowed to rise, while careful monitoring of the patient is required. A positive test is defined by the complete absence of respiratory effort under these conditions[2].

Numerous complications were reported during the apnea test used in the diagnosis of brain death[3-8]. The occurrence of subcutaneous emphysema and pneumothorax during apnea testing is relatively rare, and many physicians may not be aware of the possibility of these complications. The mechanism for this situation was as follows: direct trauma to the tracheobronchial tree during catheter insertion for oxygen delivery and another mechanism is excessive air trapping in the lungs due to the high flow rate of oxygen. As a result it can cause increased pressure in the lungs and even pneumothorax. This may result in acute hemodynamic or pulmonary instability and even cardiac arrest, as well as lead to premature termination of the apnea test or decreased perfusion of organs that can be employed to transplantation[3-8].

In this case report, we aimed to present the diagnosis and treatment modalities of a patient who developed subcutaneous emphysema and pneumothorax during the apnea test.

Case report

A 44-year-old female patient who was operated on for bleeding from the PICA aneurysm was admitted to the intensive care unit due to impaired consciousness. Although no pathology was detected on the cranial CT scan of the patient, the patient was intubated orotracheal, and mechanical ventilation treatment was started because infiltrates were found in PA lung X-ray and Glasgow Coma Scale was $E_4M_3V_1$. The patient had a history of hydrocephalus.

Percutaneous tracheotomy was performed on the 11th day of hospitalization. On the 49th day of hospitalization, no brain or brain stem reflexes could be found in the patient. The patient's body temperature was 36.6°C and blood pressure was 110/70. The chest radiograph of the patient who received dopamine at a dose of 5 ug/kg/min was normal. After pre-oxygenation with 100% oxygen from the patient whose cardiovascular functions were stable, the partial oxygen pressure in arterial blood gas was 559 mmHg. The patient, who also met other conditions before the apnea test, was withdrawn from the mechanical ventilator and a 12-french catheter was placed 4-5 cm below the tracheotomy cannula to provide an oxygen flow of 4 L/min. Subcutaneous emphysema was detected in the face and chest area of the patient 1 minute later. Tachycardia of up to 160 beats/minute developed in the patient. In the lung auscultation performed in the patient whose apnea test was terminated, and he was connected to a mechanical ventilator, bilateral respiratory sounds were absent. Bilateral pneumothorax was detected in the PA lung X-ray taken with the patient, and bilateral tube thoracostomy was performed. Although subcutaneous emphysema and pneumothorax did not progress, the patient was considered dead one day after the apnea test could not be performed again, since hemodynamic stability could not be achieved.

Discussion

In this case report, subcutaneous emphysema and pneumothorax developing during the apnea test were reported.

Different cases of pneumothorax development during apnea testing have been reported in the literature[3-8]. The pneumothorax cases were evaluated in a systemic review published by Gorton et al.[3]. It was pointed out that the development of pneumothorax was rapid-mostly in minutes-in most of the patients. In the same review, it was reported that in a significant part of the cases, absence of breath sounds, development of hypoxia, and detection of subcutaneous emphysema were symptoms of pneumothorax. In our patient, similar to the review, subcutaneous emphysema developed within minutes after oxygen administration at the beginning of the apnea test. There were no bilateral breath sounds on lung auscultation. The development of subcutaneous emphysema during oxygen insufflation at the beginning of the apnea test made us think that the patient might develop pneumothorax. The definitive diagnosis of the patient was made with thorax CT.

The mechanism of development of subcutaneous emphysema and pneumothorax during the apnea test has not been clearly defined. The first possible mechanism is direct trauma to the tracheobronchial tree during catheter insertion for oxygen delivery; This mechanism may be valid in our patient as the symptoms develop immediately. Another mechanism is excessive air trapping in the lungs due to the high flow rate[3-5]. High flow rates (high 6 L/min) can cause tracheobronchial trauma. Air entrapment may occur if the oxygen cannula occludes most of the diameter of the tracheotomy or endotracheal tube. The high flow rate is believed to cause the development of subcutaneous emphysema and pneumothorax[3-5]. Gorton et al.,[3], in their review, recommended using a small oxygen insufflation catheter that would not obstruct

the lumen of the endotracheal tube, using tape to fix the oxygen insufflation catheter, and not advancing the insufflation catheter deeper than 35 cm. Goranovic et al.[4] reported that during the apnea test, the diameter ratio of the endotracheal tube/insufflation catheter <1.75 and the O_2 flow >10 L/minute may be related to high insufflation pressures. In their case report, the patient had high pressure at the end of the insufflation catheter and direct contact of the insufflation catheter with the trachea, which could have caused a small perforation of the tracheal membrane. This perforation was manifested by noise, shoulder, and upper thorax movements, subcutaneous emphysema, and apical pneumothorax. In the study of Henry et al.[6] on manikins, it was reported that the use of an insufflation catheter with a diameter less than 70% of the inner diameter of the endotracheal tube and 6 L / min of airflow may reduce the risk of procedural complications. In another study, the authors recommended using a cannula that is significantly smaller than the inside diameter of the endotracheal tube to avoid air trapping during the apneic oxygenation procedure[7]. In our patient, we advanced the oxygen insufflation cannula[4-5] cm into the tracheotomy cannula and our oxygen flow rate was 4 l/minute. We used a 12 french aspiration tube to deliver oxygen to our patient, and the patient had a 7.5 tracheotomy cannula. In most of the publications, the patient was given an apnea test in the first few days of admission to intensive care, but in our case, we administered an apnea test to the patient on the forty-ninth day, we think that weakening and thinning of the trachea may increase the risk of developing subcutaneous emphysema and pneumothorax.

Gorton et al[5]. reported in their study that the apnea test was repeated in only half of the cases that developed pneumothorax during the apnea test. The same authors reported that in some cases that developed pneumothorax in their case series, the heart and lung were excluded from the donation list. This situation will result in the inability to use the organs even if the patients are diagnosed with brain death. In our case, the apnea test could not be performed again due to hemodynamic instability and the patient died the next day.

When brain death guidelines are reviewed, the frequently used American Academy of Neurology guidelines recommend 6 L/min oxygen administration with an oxygen cannula placed at the level of the carina through the endotracheal tube, but there is no recommendation on the size of the oxygen cannula[2]. In the ANZIC guideline, another resource used in the diagnosis of brain death, attention is drawn to pneumothorax that may develop during the apnea test[8].

As a result, if hemodynamic deterioration develops during the apnea test, pneumothorax should be considered and prompt treatment should be provided. We believe that all physicians performing apnea tests should consider the possibility of this complication.

Conflict of interest

Authors do not have any conflict of interest to declare.

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