CHALLENGES IN CRITICAL CARE:
THE BROOKLYN HOSPITAL CENTER—
CAPNOGRAPHY, A VALUABLE ASSET

MAQUET

The Brooklyn Hospital Center

MAQUET

Cossette Communications       415 Madison Avenue – New York, NY 10017       212.573.4700
Founded in 1845, The Brooklyn Hospital Center (TBHC) has become a major healthcare resource for the residents of New York City’s largest borough. Equipped with the most sophisticated diagnostic and therapeutic modalities and state-of-the-art technology, TBHC is committed to excellence in patient care.

To provide the best possible respiratory care to the 200,000 patients it sees annually, the hospital has a fleet of MAQUET SERVO-i ventilators equipped with advanced functionality.

Among the SERVO-i’s advanced features is an optional analyzer/monitor capable of measuring expiratory carbon dioxide (CO₂) concentrations during a respiratory cycle. Results of the measurement of CO₂, referred to as capnography, are graphically displayed on the ventilator screen in a breath-by-breath waveform or capnogram.

The multi-disciplinary respiratory care team at TBHC finds that capnography is very useful as a noninvasive monitor for assessing ventilated patients.

While not a replacement or substitute for arterial blood gas sampling, the CO₂ analyzer allows for assessment of a placement of an endotracheal tube in the patient’s airway, ventilator settings and similar measurements, says M. Shahjahan, RRT-NPS, RPFT, Director of Respiratory Care Services. The trend information that the analyzer provides is valuable for reviewing the effectiveness of changes in the ventilator settings and also during weaning from the ventilator, he says.

Waveform can provide assurances, suggest when changes may be needed: To use the CO₂ analyzer, an airway adapter is placed at the Y-piece and a sensor snapped onto the airway adapter. The CO₂ analyzer module receives signals from the infrared sensor that reflect the variations of CO₂ in the expiratory gas. The monitoring, which is continuous, is shown both in a waveform and numeric value indicating the CO₂ concentration of the end tidal carbon dioxide concentration (ETCO₂) and the rate of elimination of CO₂ or V̇CO₂.

Shahjahan explains that the shape of the waveform can indicate changes in the patient’s condition. “If you look at the waveform, and if it is square, you know you are dealing with very good lungs and a relatively normal lung function. As the patient’s lung function is improving, a squarer waveform is a very good sign.”

However, he says, if the waveform is non-constant (not square), it can suggest that adjustments need to be made in settings. “If the waveform is slowly rising, it tells you that you don’t have uniform ventilation, and you may have to do something to aid in the resolution of the disease or clinical condition that is emerging,” Shahjahan says.

CO₂ monitoring also gives the staff assurance that the ET tube is in the trachea, says Rana Ali, MD, Medical Director of the Respiratory Care Unit. CO₂ monitoring is valuable during recruitment, allowing heart problems to be detected early, says Farhad Arjomond, MD, Medical Director, Respiratory Care Services.

CO₂ monitoring is valuable during recruitment, allowing heart problems to be detected early, says Farhad Arjomond, MD, Medical Director, Respiratory Care Services, and adds that the monitoring device also is very useful during recruitment maneuvers where high transpulmonary pressures may cause a fall in preload and cardiac output. “A sudden drop in ETCO₂ may mean low pulmonary perfusion, therefore, higher PaCO₂ to ETCO₂ difference.”

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CO₂ analyzer has benefits in the OR and in pediatric ICU:

Shahjahan says the CO₂ monitoring device is of most value in the operating theater to confirm the placement and continued secure presence of the endotracheal tube in the trachea. He says ETCO₂ monitoring works very well in the OR where airway secretions clogging the airway adapter are not a problem since most patients receive medication to dry their airway secretions during surgery. “We had an anesthesiologist as the CEO here who insisted on using ETCO₂ monitoring in all ventilated patients.”

At TBHC, capnography also plays a significant role in the ventilatory management of patients in pediatric intensive care unit (PICU).

A few years ago, Shahjahan and his colleagues presented a paper on their experience with the use of ETCO₂ monitoring at a meeting of the American Thoracic Society (ATS). The SERVO-i ventilator system is designed for use with patient populations from neonates to adults. The hospital center has 42 ventilators in its fleet; it uses the SERVO-i ventilator exclusively for patients of all age groups.

The respiratory care staff also finds capnography can provide good assessment of hypercapnic episodes, which can be life-threatening, during weaning. If the waveform suggests an unusually high level of carbon dioxide in the blood during weaning, the procedure may need to be re-evaluated, Shahjahan says.

While TBHC’s respiratory care staff has confidence in the CO₂ measurements it sees on the SERVO-i screen, it never relies solely on them to make adjustments or changes in the patient’s care. The physicians will always confirm what they are seeing by an arterial blood gas (ABG) before making changes, Shahjahan says.

Capnograms reflective of various conditions

- Hyperventilation and Hypoventilation
- Chronic Obstructive Pulmonary Disease
- Cheyne-Stokes Breathing
- Cardiac Oscillations
- Rebreathing of Exhaled Air

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M. Shahjahan, RRT-NPS, APFT, Director of Respiratory Care Services

Alarm setting on CO2 analyzer alerts staff to issues that need quick response: It is important to remember that the success of the CO2 analyzer depends on a clear airway adapter, Shahjahan says. “You have to inspect the airway adapter to make sure it is clear and only then will you be able to use it. If it is not clear, it will interfere with the infrared transmission.”

The analyzer also has an alarm that can be set to indicate when CO2 levels are too high or too low. “When we use the analyzer, it has an alarm that we set and anytime there is a deviation, the alarm will be activated so we can get to the patient’s bedside immediately,” Ali says.

Monitoring capabilities help hospital teach residents, care for elderly and critically ill patient populations: Located just across the bridge from Manhattan, TBHC, a member of the New York-Presbyterian Healthcare System, is also an academic and clinical affiliate of the Weill Medical College of Cornell University. A teaching hospital, it trains more than 250 physicians each year. Having the CO2 monitoring capabilities on the SERVO-i is very helpful when working with residents, Ali says. “The more monitoring you have on your ventilators the better, because you have more tools to teach the residents,” she explains.

Because of its location, The Brooklyn Hospital Center serves a large elderly population, many of whom are smokers. As a result, many have respiratory problems requiring mechanical ventilation, Shahjahan says. The hospital also sees a large number of patients with sickle cell anemia and with HIV who can develop respiratory failure.

Shahjahan, who as director must keep an eye on expenditures, says that high-tech features such as capnography “are the way to go to make your job easier” while providing state-of-the-art care. “Most institutions today don’t have big budgets,” he says, “so the more such high tech comes into play, the more it makes your life easier while meeting your mission of providing superior patient care.”

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