



FEATURES

Weaning the 'Unweanable'

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SUNY Downstate Medical Center is one of a limited but growing number of hospitals in the U.S. using a new form of mechanical ventilation called biphasic cuirass ventilation (BCV).

Considered to be a refinement of the iron lung, BCV is a method of external ventilation that requires the patient to wear an external upper body shell called a "cuirass" so named after the breast- and back-plated body armor once worn by medieval soldiers.

Ventilation is biphasic because the cuirass is attached to a pump that controls both the inspiratory and expiratory phases of the respiratory cycle. As such, it is possible to achieve both large tidal volumes and a high respiratory rate (from six to 1,200 breaths per minute) thus allowing control over the inspiratory and expiratory (I:E) ratio.

The I:E ratio refers to the ratio between the time allowed for inspiration (pumping air out of the cuirass and creating a negative pressure around the chest) and expiration (pumping air into the cuirass and creating an increase in pressure around the chest). Most other types of ventilation methods depend on the passive recoil of the patient's chest, which limits the respiratory rate.

Pros of BCV

BCV is noninvasive and therefore avoids complications such as infection and barotraumas often associated with invasive ventilation.

Unlike intermittent positive pressure ventilation (IPPV), BCV is active in both the inspiratory and expiratory phases.

BCV may also help to maintain and redevelop the respiratory muscles, which may weaken with respiratory failure and conventional mechanical ventilation, thus allowing patients to be weaned from a ventilator.

BCV also does not impair cardiac function as much as IPPV.

The oscillations caused by BCV assist in the removal of secretions that are a symptom of many respiratory diseases.

Lastly, because BCV does not require the patient to be intubated or to have a tracheostomy, patients can receive BCV at home.

Ideal BCV Patient

BCV is typically indicated for the respiratory management for patients who have diminished respiratory muscle control or for whom the work of breathing exceeds their ability.

Patients with conditions such as acute respiratory failure, tracheal stenosis, chronic obstructive pulmonary disease, pneumonia, spinal muscular atrophy, Duchenne muscular dystrophy, Guillain-Barré, asthma, cystic fibrosis, post microlaryngeal surgery, failed fiberoptic intubation,



cardiothoracic surgery, difficult weaning from mechanical ventilation, and need for postop hyperventilation are considered good candidates for BCV.

External ventilation has been used successfully in children with heart failure and pneumonia, hypoventilation, bronchiolitis obliterans, bronchiolitis and pneumonia, ataxia telangiectasia, bronchiectasis, and restrictive pulmonary disease.

Case Scenario

J.H. is a 23-year-old female who was admitted to SUNY Downstate Medical Center for treatment respiratory failure related to bilateral pneumonia. She has a history of asthma, scoliosis, severe chronic/restrictive lung



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disease, spina bifida, anemia, sleep apnea, has recovered from 14 surgeries, including five spinal surgeries, and survived two cardiopulmonary resuscitations.

J.H. came to the hospital requiring complete ventilatory support and was initially considered "unweanable." She had three previous intubations, currently has a tracheostomy, and was undergoing a prolonged weaning from mechanical ventilation when the healthcare team decided to utilize BCV.

J.H. is young, motivated, and was determined to return home. Once the decision was made, she was weaned from complete ventilatory support within 2 weeks. After the initial adjustment period of a few days, J.H. was able to tolerate the BCV for most of the day and was only returned to IPPV at night. In just over a week, she was trialed on a tracheostomy collar with 40 percent O2 for 3-4 hours at a time.



FRESH AIR: Jenelle Hopgood is the first patient at SUNY Downstate to use the BCV. Opposite page, Hopgood is cared for by Collette Marriott, RN, nurse manager, and above, she and her mother, Nancy Zaragoza, are joined by nursing and respiratory staff.

In just over 2 weeks, J. H. was maintained on 40 percent humidified O2 via trach collar during the day, and used the cuirass at night. As J.H. has a history of CO2 retention, she was placed on continuous CO2 monitoring while the cuirass was in use.

When asked about her experience with BCV, J.H. wrote, "When they first put it on me, I was nervous about how it would feel. It felt different because my body wasn't used to it. I felt discomfort at first, but as my body got adjusted to it, I felt much better and the discomfort was no longer there. In the beginning I was on it for 24 hours, but as I got better, now I use it only to go to bed. To me that says a lot. I feel it is worth using it because it has helped me maintain a low CO2 level, and helping my lungs expand so I can breathe better."

J.H. was discharged to home after more than 3 months of intensive therapy on an inpatient surgical unit. She has returned to the outpatient clinic several times since discharge and is doing well.

Respiratory Care and Nursing

The care of patients with BCV depends on a well-developed, transdisciplinary plan of care that includes respiratory therapists, nurses, physicians, physical therapists, dietitians, case managers, and the patient and family.

Family/significant other involvement in care is key as the goal is to return patients to their home environment. Patient and family education, collaborative teamwork among healthcare providers - particularly the partnership between nurses and respiratory therapists - is paramount. Consistent nursing assignments (same nurses caring for the patient and family as much as possible) help to foster a sense of safety and security for patients experiencing BCV.



The article's authors (from left) Stephen Marrone, EdD, RN-BC, CTN-A, Julie Eason, BS, RRT-NPS, Claudette McLeod, MSN, RN, and Marriott.

The nursing and respiratory care management of patients with BCV centers on instructing the patient and family regarding the indications for BCV, how it works, the application of the cuirass, and care of the patient and equipment. Psychosocial assessment and support are embedded in the care of the patient and family members.

Other aspects of care involve assessment of the patient's respiratory status, breath sounds, oxygen saturation level, CO2 level, vital signs and heart rhythm. Monitoring for signs and symptoms of respiratory distress such as shortness of

breath, accessory muscle use, change in the level of consciousness, cyanosis, tachycardia and tachypnea are key elements of assessment for the caregiver and key elements of education for the patient and family.

Since J.H. has a tracheostomy, daily tracheostomy care, suctioning, and does deep breathing and coughing exercises as needed. As CO2 retention is an area of concern for J.H., a CO2 monitor is routinely in place at the bedside.

Eliminating the hazards of immobility is another focus of nursing care, particularly the prevention of alterations in skin integrity that may result from the pressure of the cuirass shell on the patient's skin. Therefore, attention is necessary to ensure the shell is placed over clothing and not directly onto the patient's skin.

Typically, dependant areas of the body are prone to skin breakdown. Patients with the cuirass device, however, must also be assessed for breakdown on the anterior and lateral aspects of the chest where the device comes in contact with the patient. Nurses examined J.H.'s skin every shift for signs of skin breakdown, especially around the edges of the shell.

In addition, it is critical for nurses to assist the patient from the bed to/from the chair throughout the day, as tolerated, and for physical therapists to provide range of motion exercises to prevent joint contractures and to build muscle strength. As moving to/from the bed/chair increases oxygen consumption, these activities must be timed so they do not conflict with other activities such as meals or toileting. It is important to give the patient time to recover from activities that increase oxygen tissue demands.

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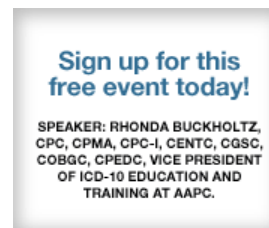
Watch this video to see how respiratory therapists are using biphasic cuirass ventilation to help a new generation of patients.

Nutritional Needs

Adequate nutrition and hydration are also essential in the care and recovery of BCV patients. As there is an increased risk of aspiration if the patient eats while the shell is in operation, it is important to be aware of the risk and, if possible, coordinate mealtimes to prevent them from coinciding with the period when the BCV is in use.

J.H. was able to eat without difficulty with the BCV in use. Activities of daily living were also planned around the length of time allotted for the patient to be on the BCV. Given the unfamiliar hospital environment and the large amount of

equipment used in her care, J.H. was placed on falls precautions for safety as she progressed in her mastery of activities of daily living.



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Discharge instructions focused on teaching the patient and family the signs and symptoms of respiratory distress, how to obtain pulse and respiratory rate. The patient and family were instructed to report abnormal findings to physician and to call 911 if J.H. develops any signs or symptoms of respiratory distress.

Providing Hope

BCV is an ideal method of ventilation for patients who are difficult to wean using traditional weaning strategies.

BCV is a simple to use, non-invasive method to meet the ventilatory needs of the patient thereby avoiding many ventilator-associated complications.

Most importantly, BCV provides hope to patients with chronic respiratory failure who wish to return home and resume as many activities of daily living as physiologically possible.

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