Special Report:
electrical activity of the diaphragm (Edi)

Signaling a new era in adult respiratory therapy

If you're not familiar with the diagnostic tool of Edi signal monitoring to help improve the outcomes of respiratory therapy, chances are you soon will be. Respiratory Education Coordinator Tara Managan, BSRT, RRT, RRT-ACCS, is one of a growing number of respiratory professionals who predicts that in the near future, "tracking the electrical activity of the diaphragm (Edi) will become just one more vital sign to monitor when gathering critical information about the patient's respiratory performance and overall health."

Current technology makes it possible to conduct minimally invasive Edi monitoring whether or not the individual is being assisted by mechanical ventilation – an important diagnostic resource for assessing tolerance during the crucial weaning process and after mechanical ventilation has ended.

The capability to monitor the electrical activity of the diaphragm at bedside was pioneered by Getinge as part of the neurally adjusted ventilator assist mode (NAVA) of its Servo mechanical ventilator platform. NAVA first gained widespread acceptance in the United States for its unique ability to enhance neonatal respiratory management and in recent years has been increasingly employed with similar success for adults requiring mechanical ventilation.

NAVA delivers assistance in proportion to, and in synchrony with, the patient's own respiratory efforts where the electrical activity of the diaphragm helps control and optimize ventilator assistance on a continuous basis.

As Managan notes: "It has been well documented that mechanical ventilation which is not synchronized with the patients' efforts can significantly delay recovery, prolong the duration of mechanical ventilation and contribute to diaphragmatic atrophy. Insufficient or excessive support can also exacerbate these problems."

With this in mind, Managan is quick to point out that Edi monitoring is capable of detecting respiratory distress in real time often before hemodynamic or physiology changes reveal themselves.

"The stakes are quite high when you consider the short- and long-term consequences of frequent over-assistance. No less important is the day-to-day challenge to accurately evaluate the adult patient's readiness for mechanical ventilation weaning."

Managan cites a number of clinical studies that help make the case for continuous adjustments to ventilator support through Edi monitoring.

Levin et. al.[1] showed that prolonged mechanical ventilation can lead to a reduction in protein synthesis and an increase in protein breakdown where patients experienced a decline in the muscle area of the diaphragm by as much as 50% after a brief period on mechanical ventilation.

In other studies[2], the decline in diaphragm force has been described as logarithmically associated with time on mechanical ventilation. Deep sedation accompanying mechanical ventilation may also prove to be an additional factor leading to the fast decline in muscle efficiency.

Managan calls attention to the published evidence that "as little as 12 hours of full mechanical support is sufficient to induce diaphragmatic atrophy. This is of particular concern once a patient is ready to be weaned from the ventilator since respiratory muscle strength is the key to successful extubation.

"Only Edi monitoring provides clinicians with a highly accurate and continuous read-out of diaphragmatic performance to help them appropriately adjust ventilator settings throughout the duration of therapy to help safeguard and improve diaphragm functioning."

Managan's first-hand experience is supported by the writings of Sinderby, Beck, Spahija et.al.[3] who assert that Edi is a versatile and simple instrument to monitor diaphragm activity compared with an esophageal balloon catheter that is influenced by many factors and is often unreliable, even in experienced hands.

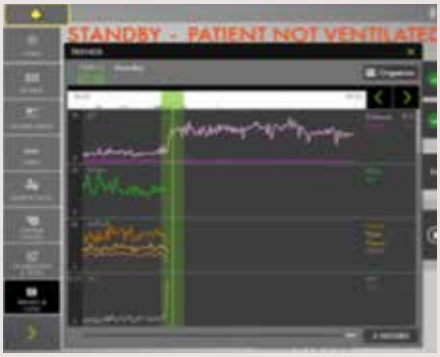
Better information. Better decisions.

Specifically, the Edi signal provides critical information about respiratory drive, volume requirements and the real-time effect of ventilator settings that help clinicians make informed decisions about their respiratory management strategies. In some instances, Edi monitoring is the only source of actionable information.

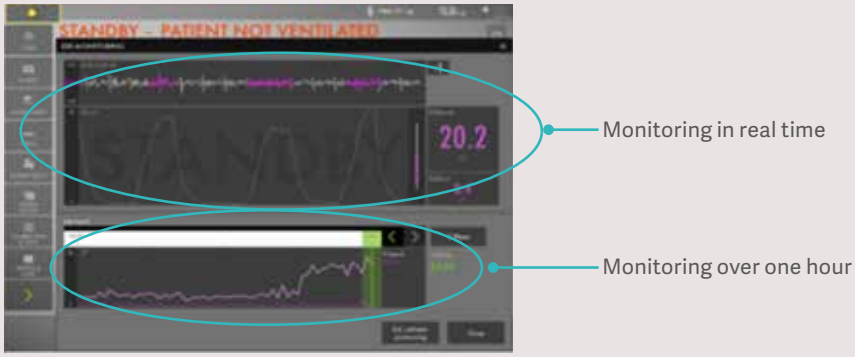
Managan points to the example that traditional pressure and flow waveform patterns for mechanically ventilated patients don't always reflect the individual's true respiratory efforts.

"Thanks to Edi monitoring, we now know with certainty when patients are trying to breathe on their own."

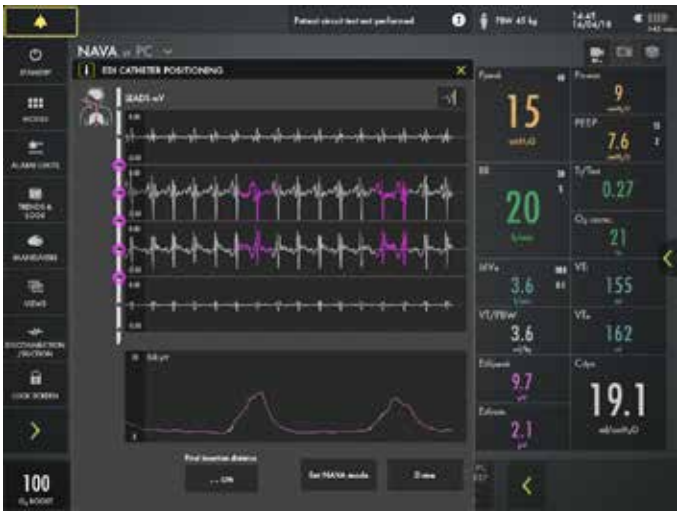
The changing amplitude of the Edi signal, itself, often strongly suggests the need to modify ventilator settings or prompt an immediate re-evaluation of the patient's condition. An increasing Edi can indicate under-assistance and a general worsening of the patient's health. Conversely, a decreasing Edi can signify over-assistance; indicate potential over-sedation and/or the need for sedation monitoring; and signal the possibility that weaning and extubation can be implemented.



Edi Monitoring on and off ventilator



Edi monitoring in real time and over preceding hour



Three key components of optimal position include:

1. presence of P waves in the proximal lead with disappearance in distal lead
2. decrease in the QRS amplitude from the upper to the lower leads
3. diaphragm electrical activity highlighted mostly in the central leads (in purple)

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Minimally invasive. Clinician friendly.

A specific nasogastric 8, 12 or 16Fr feeding tube is employed for Edi monitoring whose distal tip is equipped with multiple electrodes that detect and measure diaphragmatic movement and strength viewed as a waveform on the ventilator monitor. An Edi catheter positioning screen facilitates proper placement.

The Edi catheter is typically inserted via nare after mechanical ventilation has been initiated. Patients with an endotracheal or tracheostomy tube also are suitable candidates for Edi monitoring. Tracheostomy patients in particular greatly benefit from the placement of an Edi catheter since they often are more difficult to wean from mechanical ventilation.

In addition, the Edi catheter can be placed independently of the endotracheal tube, tracheostomy tube and non-invasive ventilation (NIV) interface—including NIV NAVA—without disrupting other aspects of patient intervention.

Waveform screens for Edi monitoring are designed to provide critical diagnostic information at a glance in real time and over the preceding hour to help guide ongoing therapy strategies. Tracking the Edi signal is particularly valuable in assessing tolerance during mechanical ventilation weaning. Clinicians can immediately interpret changes to the Edi value in conjunction with other vital signs when the patient is removed from ventilation and proceed accordingly. (Once mechanical ventilation is removed, an increased Edi value is an indication of the increased use of the patient's diaphragm.)

Weaning is estimated to represent 40% to 50% of the duration of mechanical ventilation making it highly advisable to conduct daily screenings for extubation readiness. (It can be expected that 20 % to 30% of all patients will fail the first extubation trial.)

Most published studies have compared NAVA to Pressure Support Ventilation (PSV)—the most prevalent assisted mechanical ventilation mode—and their relative impact on weaning,

In comparing the two, NAVA may reduce the duration of mechanical ventilation, lower peak airway pressure, boost oxygenation and improve hemodynamic stability. In non-postoperative patients, NAVA helped reduce the use of sedatives.[4]

Clinical data aside, Managan views the combination of neurally adjusted ventilator assist and Edi monitoring within a much broader, patient-focused context.

"I like to remind myself that the driving force behind every major advancement in respiratory therapy technology are the patients who require breathing support, and their families and friends who pray their loved ones will leave the hospital with a new lease on life. I have personally witnessed throughout the duration of mechanical ventilation and immediately following how the therapeutic benefits of NAVA coupled with Edi monitoring significantly contribute to the potential for happy endings."

Managan recalls one particular patient with a complicated medical history who underwent triple bypass surgery and was promptly extubated. Over the next two weeks, the patient coded three times. Following the third event, a tracheostomy tube was inserted.

It soon became apparent the patient was experiencing difficulties during the weaning process and would become distressed when placed on pressure support mode. Within a week, the decision was made to utilize NAVA and an Edi catheter was inserted to monitor diaphragm activity and strength.

"Family members reported that right away, it was apparent to them the patient was no longer physically struggling to breathe once the switch to NAVA had been made. Subsequent trach mask trials also monitored by the Edi catheter helped confirm with a high degree of confidence that the patient's custom-tailored respiratory management strategy was right on the mark. Within three weeks, a once critically ill patient had been liberated from mechanical ventilation. Simply speaking, Edi monitoring is an easy to implement best practice that truly signals the future of highly personalized respiratory care regardless of the patient's age."

To learn more about Edi monitoring and NAVA visit: getinge.com/us/product-catalog/nava/

References

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GETINGE

Manufacturer: Maquet Critical Care AB · 171 54 Solna, Sweden · Phone: +46 (0)10-335 00 00 · info@getinge.com
Sales Office, US: Getinge · 45 Barbour Pond Drive · Wayne, NJ 07470 · USA
Sales Office, Canada: Getinge Canada Ltd. · 90 Matheson Blvd West, Suite 300 · Mississauga, Ontario L5R 3R3 · Canada · 1-800-387-3341 · info-canada@getinge.com

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