Brooke Smith, MHA, RRT-NPS, RT

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Let the Baby Drive! NAVA Use in a Level IV NICU

Brooke Smith MHA, RRT-NPS

CMH Neonatal Conference 2024

Disclosures

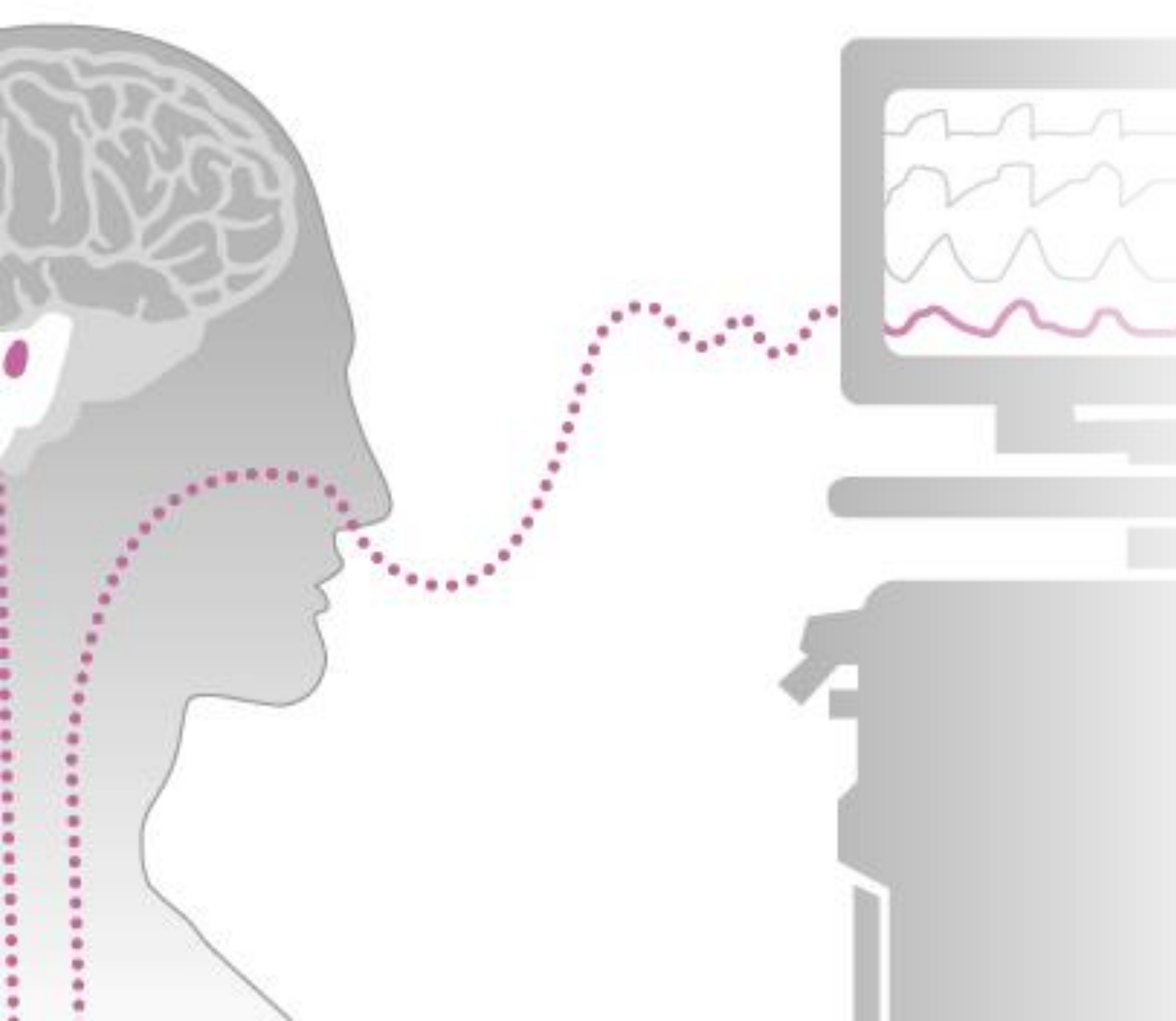
- none

CMH NICU

- 84 bed, Level 4 NICU
  - Only Level 4 NICU in 250-mile radius
- Full-range of neonatal patients--cardiac, medical, surgical, small babies, tracheostomy, ECMO, etc.
- 22 weeks- 20 months

Different uses for NAVA

- Premature Infant
- Airway Issues
- Severe BPD patient
- Non-Invasive
- Diagnostic tool



What is NAVA?

- **N**eurally **A**djusted **V**entilatory **A**ssist delivers assist in proportion to and in synchrony with the patient’s ***spontaneous*** respiratory efforts.
- Reflected by **Edi Signal**
- The patient's own Edi waveform (Signal) is used to trigger-on and cycle-off each assisted breath, also controlling the pressure delivered, thus providing truly synchronized and proportional assist
- Used with invasive and noninvasive interfaces

Physiology of the Edi Signal

- A spontaneous breath starts with an impulse generated by the brain.
- Transmitted via phrenic nerves that innervate the diaphragm.
- The signal electrically activates the diaphragm, leading to a muscle contraction.
- The electrical activity of the diaphragm is detected by electrodes embedded in a catheter and transmitted via wires from the catheter to the ventilator. .
- The ventilator assists the spontaneous breath by delivering a proportional pressure.
- NAVA uses the Edi Signal to control the ventilator and assist the patient’s breathing is dependent on their effort.
- The ventilator acts as an accessory diaphragm controlled by the patient, to help generate adequate pressure.

NAVA Ventilator Measurements

Edi:

The electrical activity of the diaphragm (Think of this as a respiratory vital sign).

Edi Peak:

Neural inspiratory effort. It is responsible for the size and duration of the breath. Goal range: 5-15 µV

Edi Min:

Spontaneous tonic activity of the diaphragm, which prevents de-recruitment of alveoli during expiration. Edi Min represents functional residual capacity. Goal range: <3µV

NAVA Ventilator Settings

Edi Trigger:

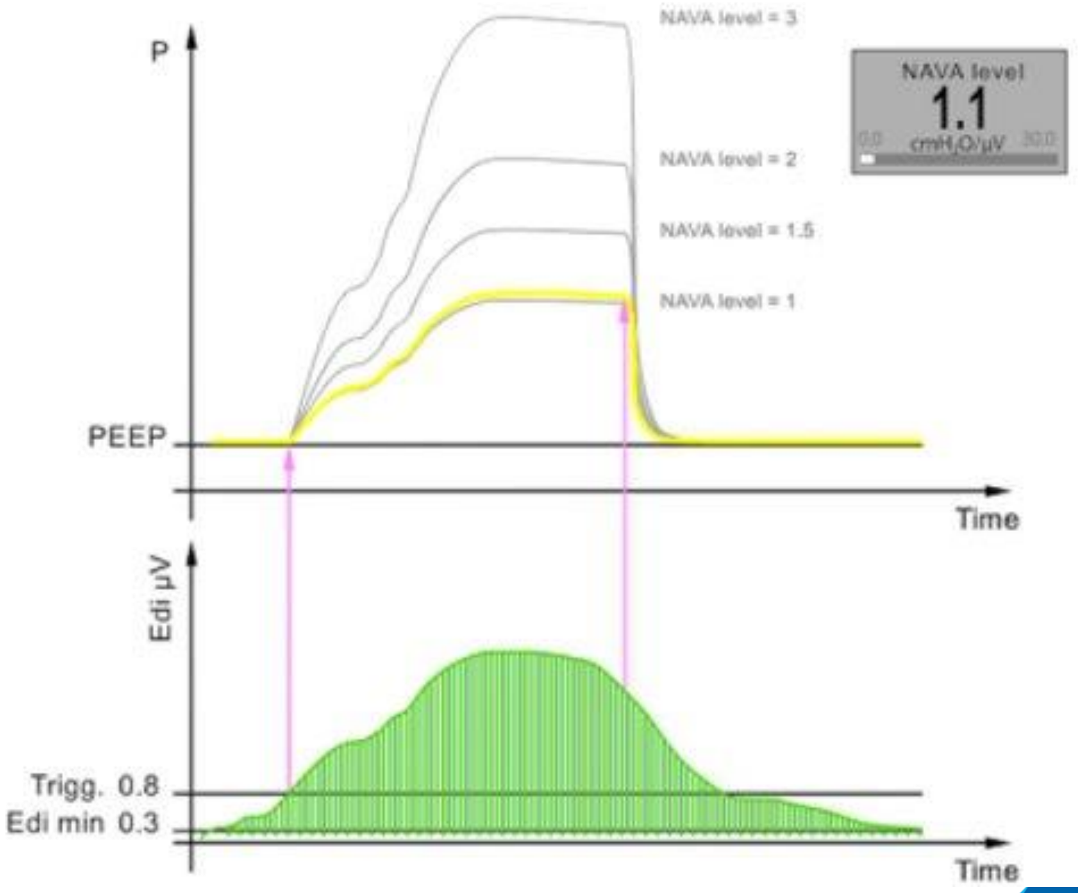
- Neurally triggered assist; triggers the ventilator to recognize the increase in electrical activity as a breath and not just baseline noise. Measured in µV.

NAVA Level:

- The conversion factor by which the Edi signal is multiplied to adjust the amount of assist delivered to the patient. Measured in cmH2O/µV.

PEEP

- Positive End Expiratory Pressure. Pressure above atmospheric, applied to the airway during exhalation, that increases functional residual capacity. Measured in cmH2O



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Management of NAVA

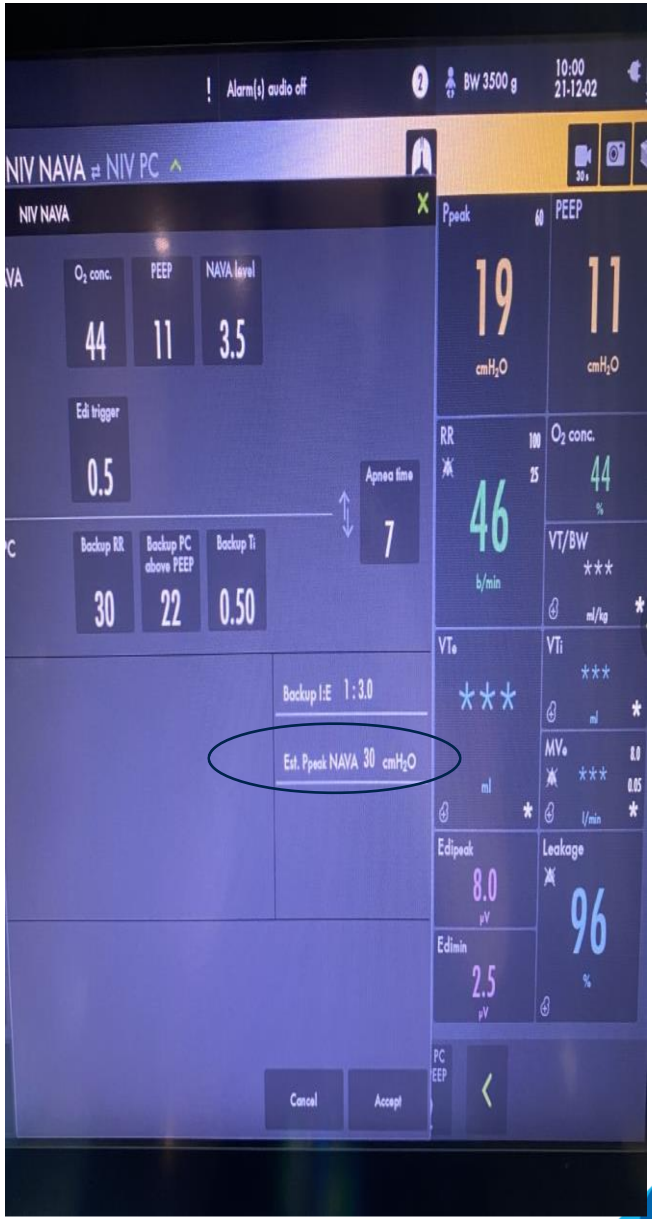
- The NAVA Level is the factor that determines how much work the patient does compared to the ventilator.
  - Peak Pressure = NAVA Level x Edi (Peak-min) + PEEP
  - Peak Pressure = NAVA Level x Edi (Peak-min) + PEEP
- Nava Level is managed based on the Edi Peak measurements.

An Edi Peak of >20 µV: → Increase Nava Level by 0.1-0.2 cmH20/µV

An Edi Peak of <5 µV: → Decreased Nava Level by 0.1-0.2 cmH20/µV

- A low Edi Peak may also indicate use of sedation, neuromuscular blockades, or hyperventilation. Wean with caution.

An Edi Min of >5 µV: → Increase PEEP by 1 cmH2O



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Other important settings:

UPL (NIV AND INVASIVE)

APNEA TIME

BACKUP RR

BACKUP PC

*Neonatal mode: allows to turn off the No patient effort alarm**

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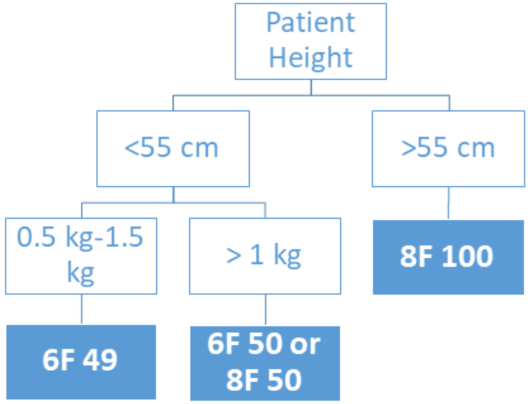
Where does it all start?

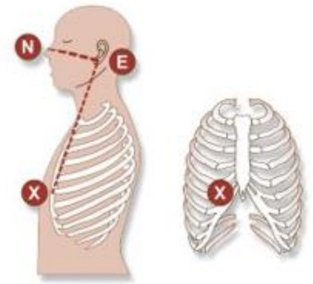
NAVA Catheter with ENFit Connector

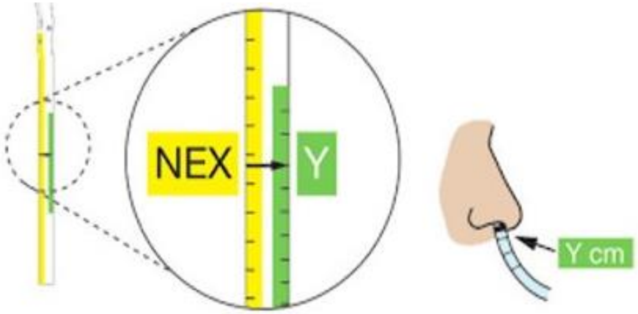
Size affects position — Height, Weight, Function

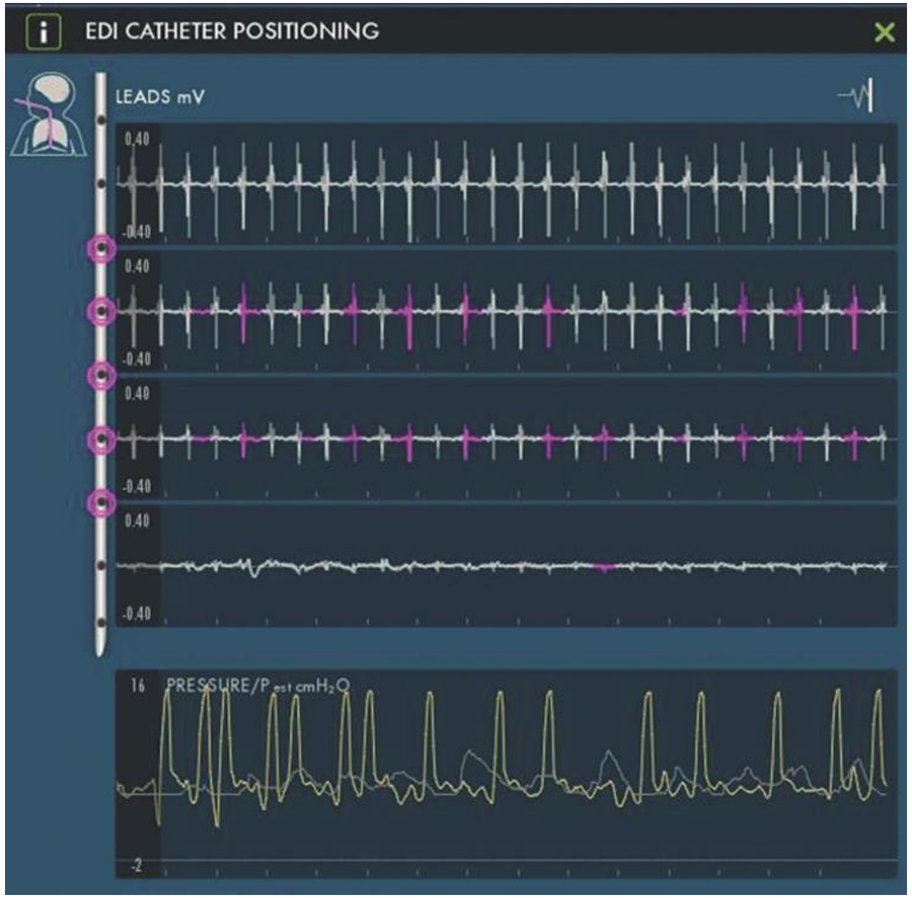
Position affects Support — Confirm position, Make sense?

Support affects BABY — WOB, CO2









Green= starting placement

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Is this the correct placement?

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Advanced it.. What about now?

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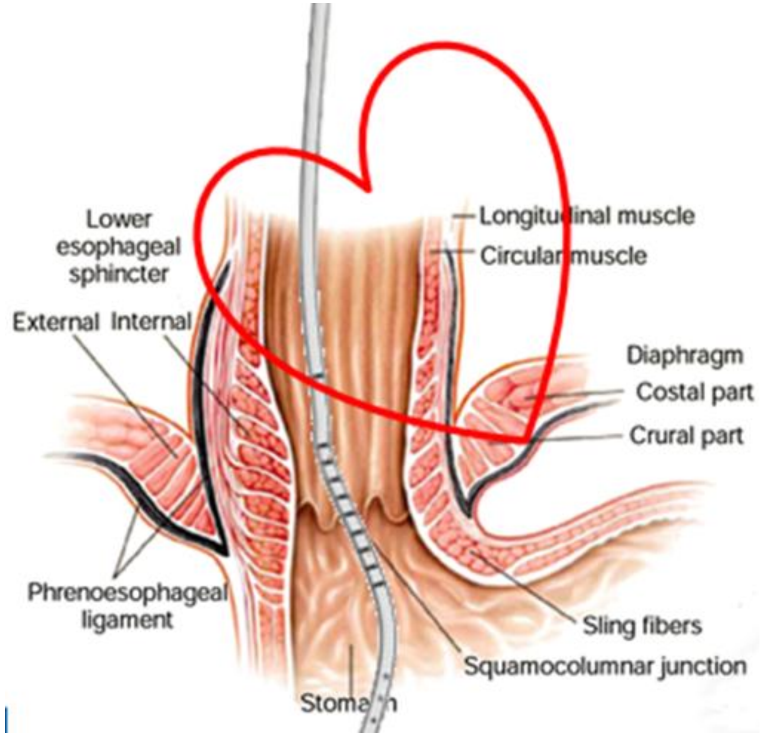

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Who is doing the work?

Vent vs Patient

Setting NAVA Level: Assessing BreakPoint

Phase1

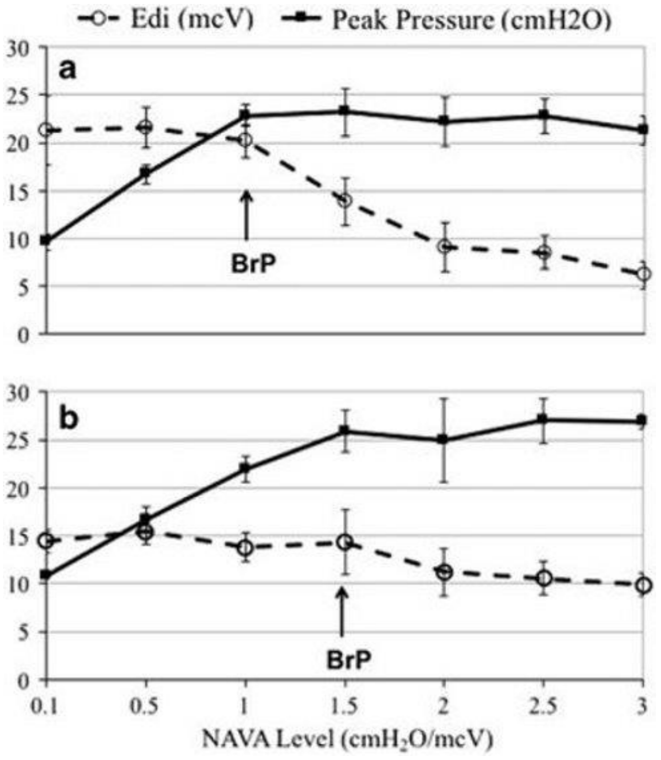
- Start with a low NAVA Level. Increase in segments of 0.2-0.5 cmH2O/uV.
- Initially, increasing the NAVA Level increases the PIP delivered.
- High Edi signal

Phase 2

- As the NAVA Level continues to increase, the Edi Peak will begin to decrease.
- The breakpoint is achieved when the PIP becomes constant and the Edi Peaks are within 5-15 uV.

Phase 3

- Increasing NAVA still decreases Edi. Increasing the NAVA Level beyond the breakpoint may result in suppression of the neural inspiratory drive (downregulation of the diaphragm).



***Comfort zone or breakpoint is a unique value in each individual*

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When do we choose NAVA?

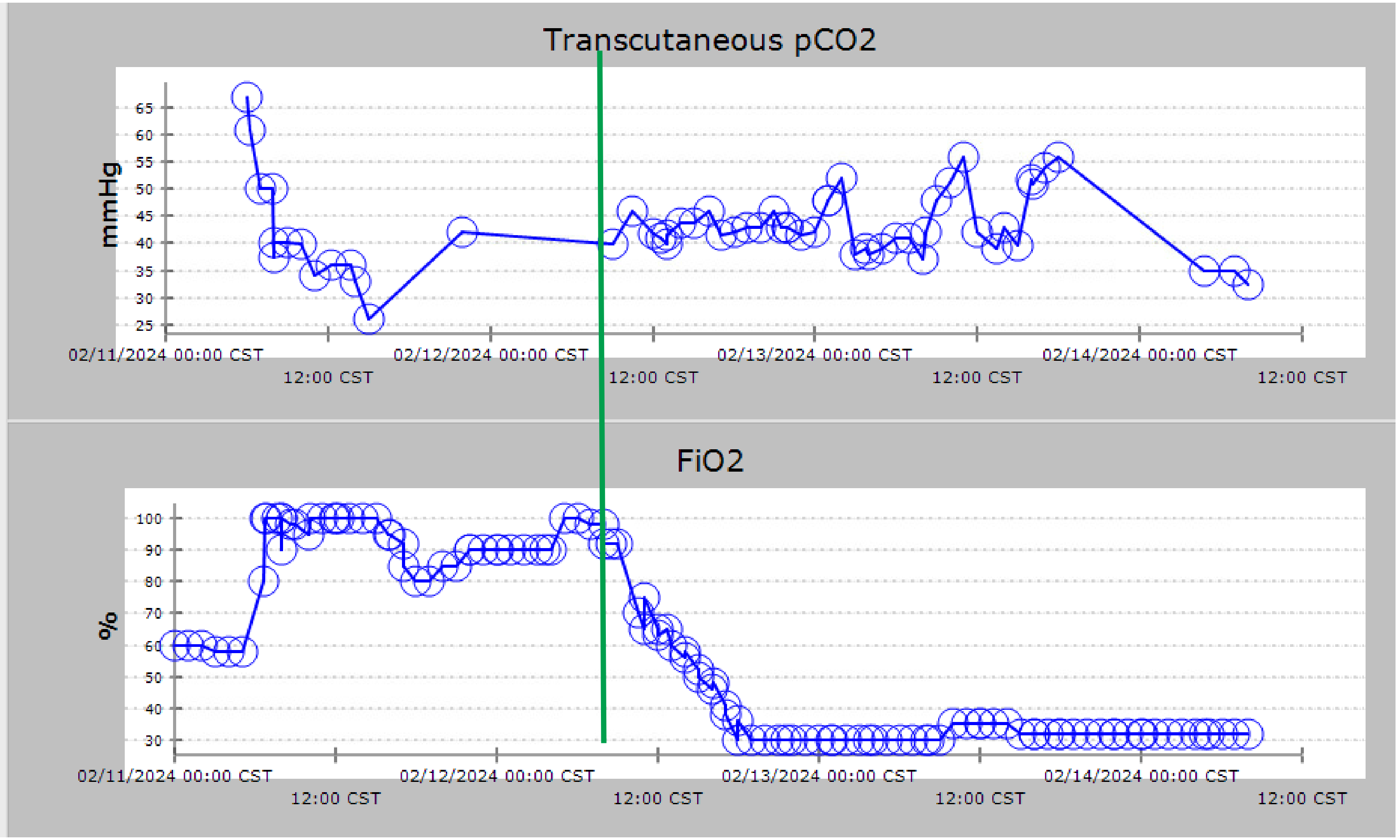
Patient-Ventilator Synchrony

- Missed Opportunity
- Premature Cycling
- Delayed Patient Triggering
- Increased Edi Peak

Assessing triggering
Sedated? Air-trapping?
Unable?

Tip: Zoom in on scalars

Synchrony/ Leaks



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Reasons we choose NAVA

- Patient synchrony
  - No missed trigger efforts
  - Shorter trigger delays
  - No premature cycling
- Decreased sedation
- Compensates for leaks- Invasive and Non-invasive
- Decreased PIP, Lower tidal volumes, decrease FiO_2
- Variable support- Adjusting the level of assistance in response to patient demand
- Recruitment- sigh breaths available & variable settings
- Avoid over- assistance
- Ability to see an increase in WOB before conventional ventilation (in numerical form).
- CPAP with apnea time

- ----Bedside monitoring of patient respiratory drive/ interaction with ventilator

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Premature population

Why?

Synchrony

Lower PIPs and Vts

Leaks

- ETT
- NIV

Important settings:

Apnea time

Backup settings

Upper Pressure limit

Monitoring

WOB

Backup

Ph/CO_2

PIP

Does the premature patient have a "good enough" drive?

European Journal of Pediatrics (2021) 180:167–175
https://doi.org/10.1007/s00431-020-03728-y

ORIGINAL ARTICLE

Check for updates

Evaluating peak inspiratory pressures and tidal volume in premature neonates on NAVA ventilation

Alison P. Protain[1,2] · Kimberly S. Firestone[2] · Neil L. McNinch[2,3] · Howard M. Stein[4,5]

Received: 8 May 2020 / Revised: 11 June 2020 / Accepted: 29 June 2020 / Published online: 6 July 2020

Abstract

Neurally adjusted ventilatory assist (NAVA) ventilation allows patients to determine their peak inspiratory pressure and tidal volume on a breath-by-breath basis. Apprehension exists about premature neonates' ability to self-regulate breath size. This study describes peak pressure and tidal volume distribution of neonates on NAVA and non-invasive NAVA. This is a retrospective study of stored ventilator data with exploratory analysis. Summary statistics were calculated. Distributional assessment of peak pressure and tidal volume were evaluated, overall and per NAVA level. Over 1 million breaths were evaluated from 56 subjects. Mean peak pressure was 16.4 ± 6.4 in the NAVA group, and 15.8 ± 6.4 in the NIV-NAVA group (*t* test, $p < 0.001$). Mean tidal volume was 3.5 ± 2.7 ml/kg.

Conclusion:In neonates on NAVA, most pressures and volumes were within or lower than recommended ranges with pressure-limited or volume-guarantee ventilation.

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Fig. 3 **a** Percent breath distribution for PIP in 5 cmH_2O increments on invasive NAVA. **b** Percent breath distribution for PIP in 5 cmH_2O increments on NIV NAVA

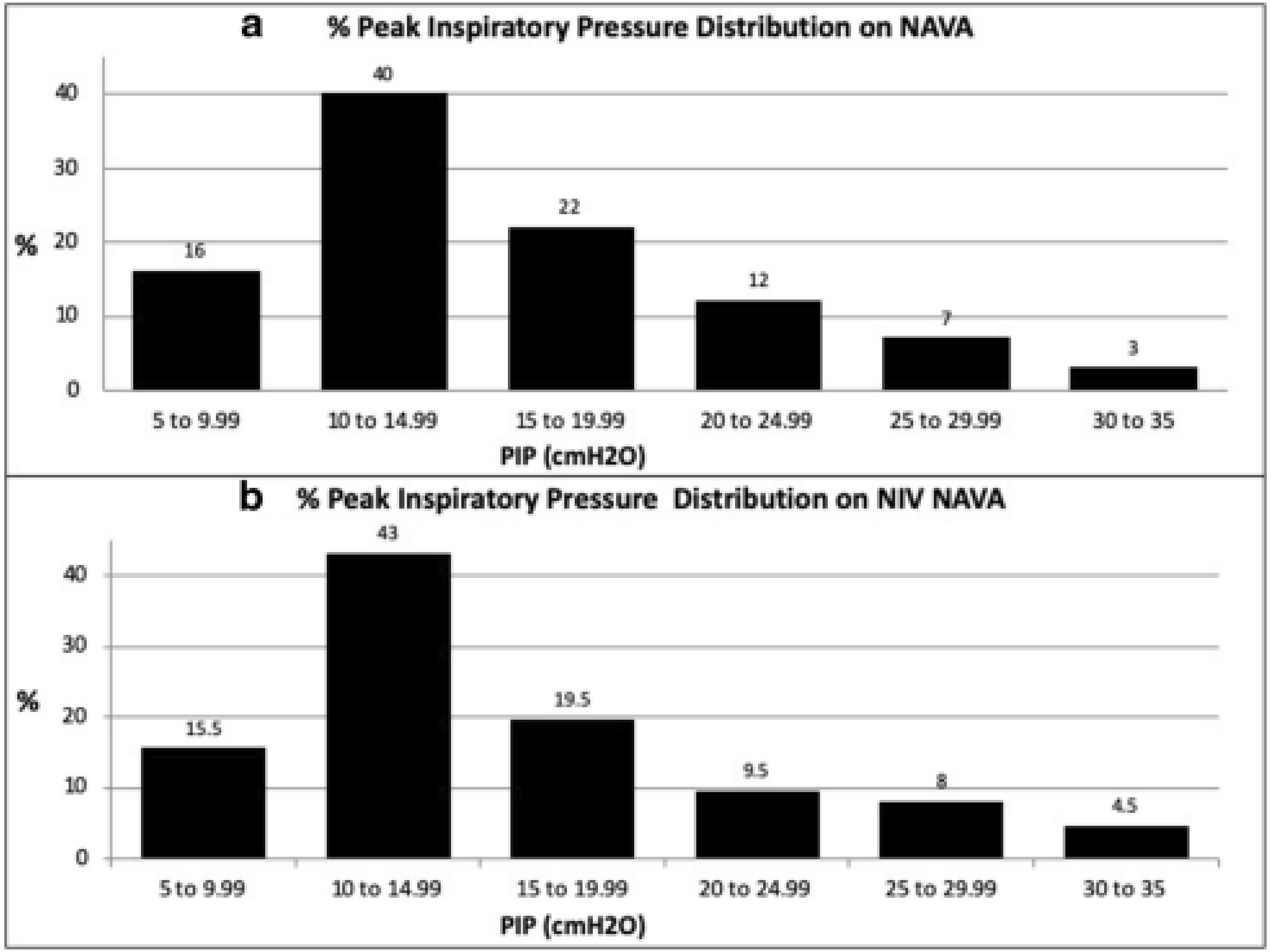

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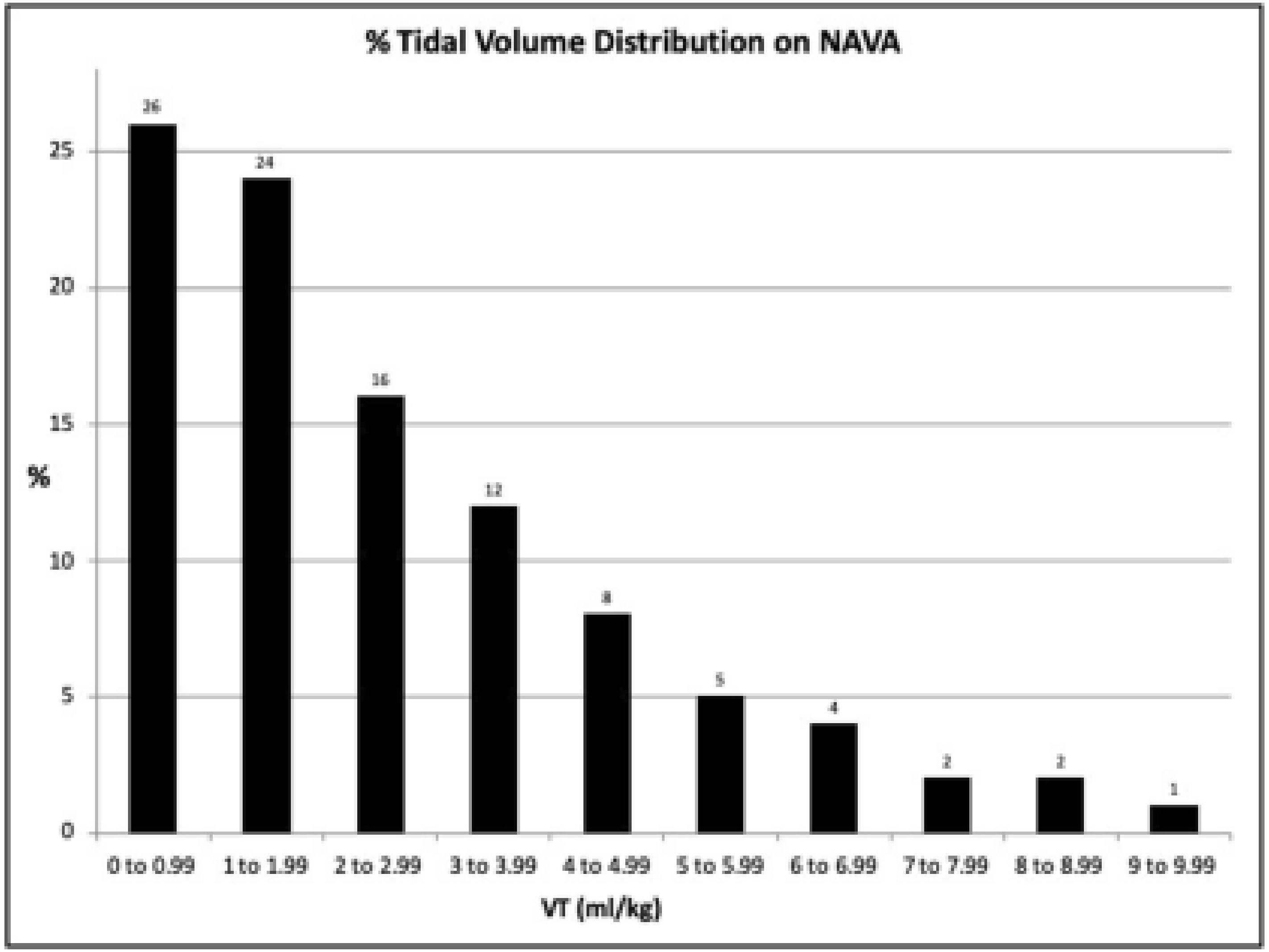
Fig. 5 Percent breath distribution for VT in 1-ml/kg increments on invasive NAVA



#1

Apnea Time = Minimum RR

- Apnea time should be customized for each patient. One major challenge when managing premature infants are respiratory variability and apnea.
- If the patient has a respiratory pause lasting more than predetermined time (apnea time), NAVA Backup (PC) is initiated until Edi activity is restored.
- *Transitioning to NAVA Backup is not considered “failing” (silence alarm)*
- Back up RR is NOT guaranteed unless apneic for full minute
- Guaranteed respiratory rate is dependent on apnea time.
    - Ex: apnea time 3= guaranteed RR (min RR) of 20
    - Goes down to 1 second

Apnea Time

- Consider watching for decompensation when setting an appropriate apnea time.
    - For example, if the patient has an a/b/d event with an apnea time of 6 seconds, consider titrating to 4 seconds and monitoring decompensation.
- If the apnea time is too short, the patient could flip prematurely. This can occur during a sigh breath and cause agitation. This can also be a false representation of the patient’s respiratory drive.

- Morgan, Firestone, & Stein
- Apnea time randomly set at either 2 or 5 seconds for 2 hours, then interchanged
- CSE monitored (bradycardia/desaturation)
- Conclusion: Fewer CSE while on shorter apnea time. Short apnea times utilized to promote clinical stability.

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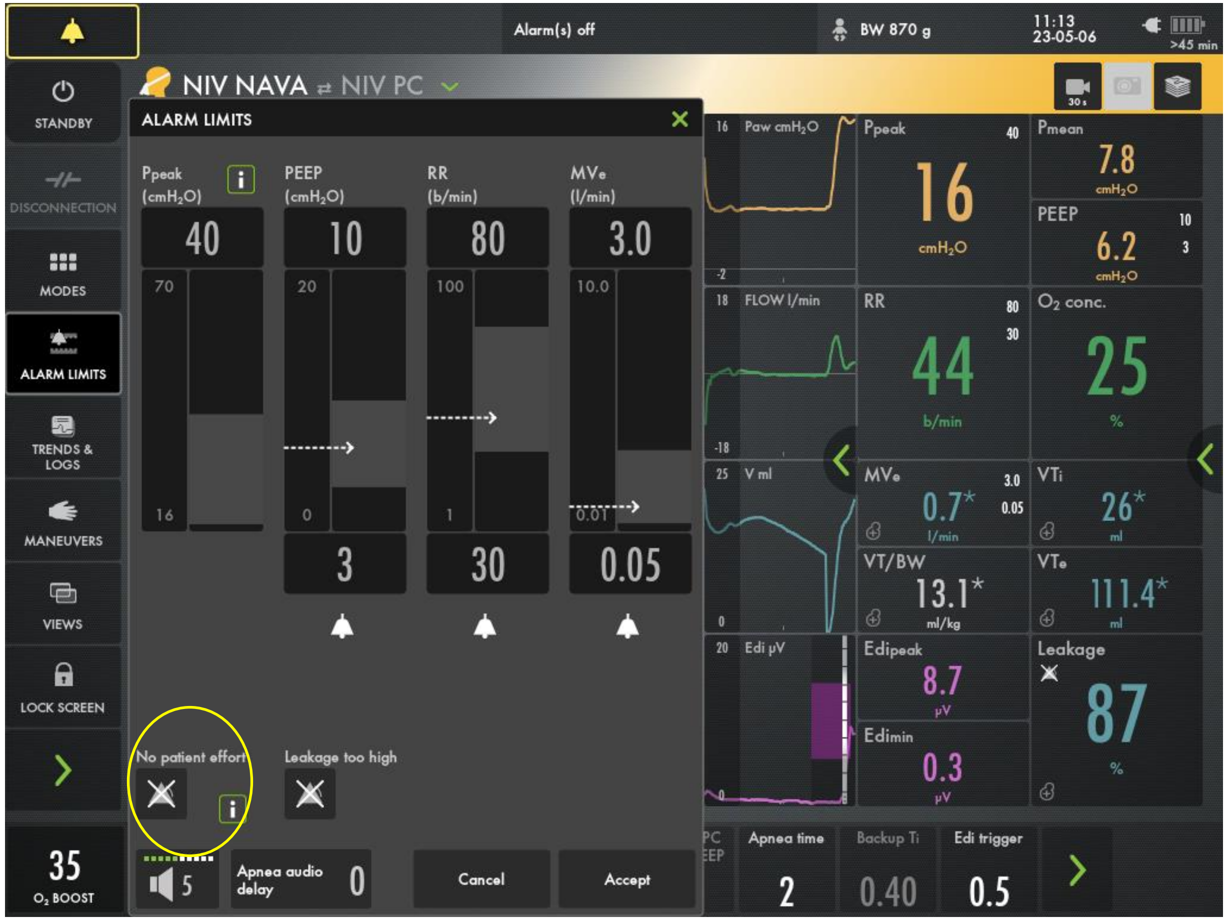
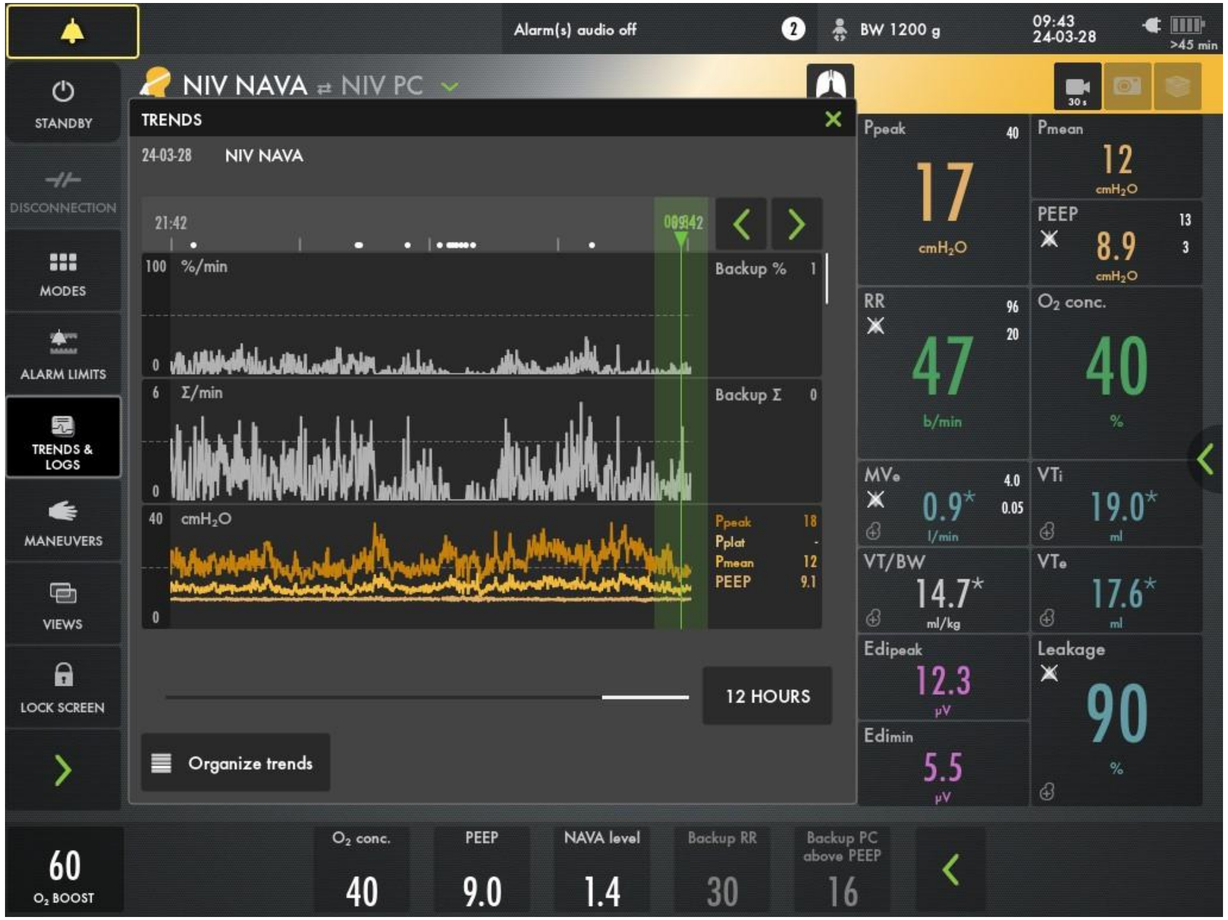
TIP: No patient Effort alarm



How is this patient's respiratory drive?

a. Not great, spend a lot of time in backup ventilation
b. Great, spend little time in backup ventilation
c. Not sure I can tell from this screen



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Are They in Backup?
(Backup % vs Backup ∑)

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Looking at trends...

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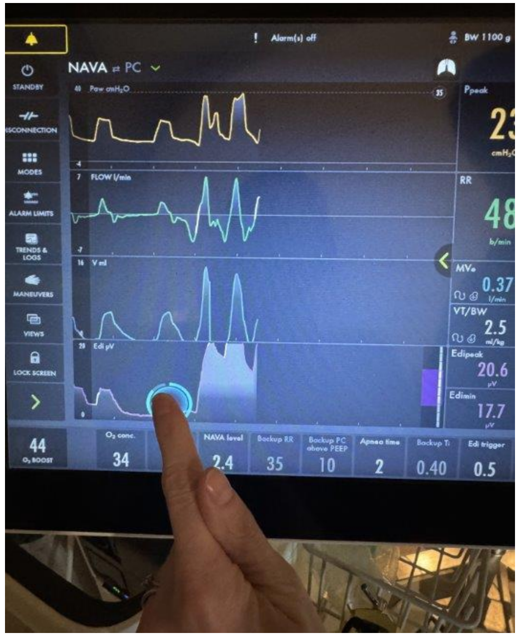
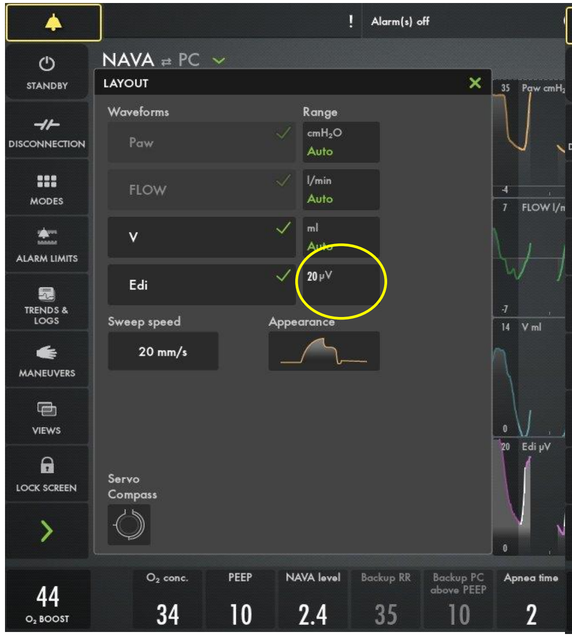
Tip: auto scale the Edi scalar





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Common troubleshooting

1

Wrong placement of catheter

- Incorrect size and/or placement

Inappropriate NAVA level

Sedation- depressing drive

Upper pressure limit- volume restricted

Apnea time

- Too long
- Too short

NAVA trigger

- Flow trigger but not NAVA trigger

Troubleshooting

Increased WOB/Increase FiO2*

- Malposition Catheter
- Under-supported (edi peak > 20 mcV)
  - Increase NAVA level
- Pressure/Flow limiting
  - Increase upper pressure limit*
- Increase Backup support

Edi Min >5 mcV, high FiO2

- Increase PEEP*

Decreased Respiratory Effort/Increase FiO2

- Malpositioned catheter
- Under-supported
  - Decrease apnea time
  - Increase backup RR
  - Increase backup PIP
- Over-supported
  - Low edi peaks, in Nava
    - Decrease nava level
  - Low Co2, high % in backup
    - Decrease back up settings
    - Lengthen out apnea time
- Decrease sedation
- Patient status?

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Acidosis or Hypercapnia

Mostly in Backup	Mostly in NAVA
Increase RR	Increase NAVA level*
Increase PIP	Decrease apnea time
Decrease apnea time	Decompress belly
Optimize caffeine	Increase upper pressure limit
Decrease sedation	

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Acceptable pCO2 and pH

Mostly in backup

- Decrease backup RR
- Decrease PIP
- Lengthen out apnea time
- Decrease sedation

Mostly in NAVA

- Wean Nava level

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Airway Issues

Why?

No lung issues

Minimum support + sigh breaths

Comfort

Settings: Low

Tip:

Monitor if going into backup settings

BPD patients

Why?

Synchrony

Crossroads

- NAVA OR Sedate

Decrease sedation

Focus on Growth and Neurodevelopment

Settings

Supportive

Nava level

Apnea time- long

UPL high*

Backup Settings –high

Monitor

Swelling

BSRI score

Living life

CXR

Back to this distressed patient..

Triggering?

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Non-Invasive

Why?

Synchronized

In combo with RAM- compensates

Decreased EFR

CPAP with apnea time

Settings

Upper pressure limit

Apnea time

Tips

Lot of support- belly?

Interface/ occlusion

Why NIV-NAVA?

- Advantages of NIV-NAVA over NIPPV:
  - Improved patient ventilator interaction
  - Reliable respiratory monitoring
  - Self regulation of respiratory support
  - Avoiding failed trigger/auto-trigger

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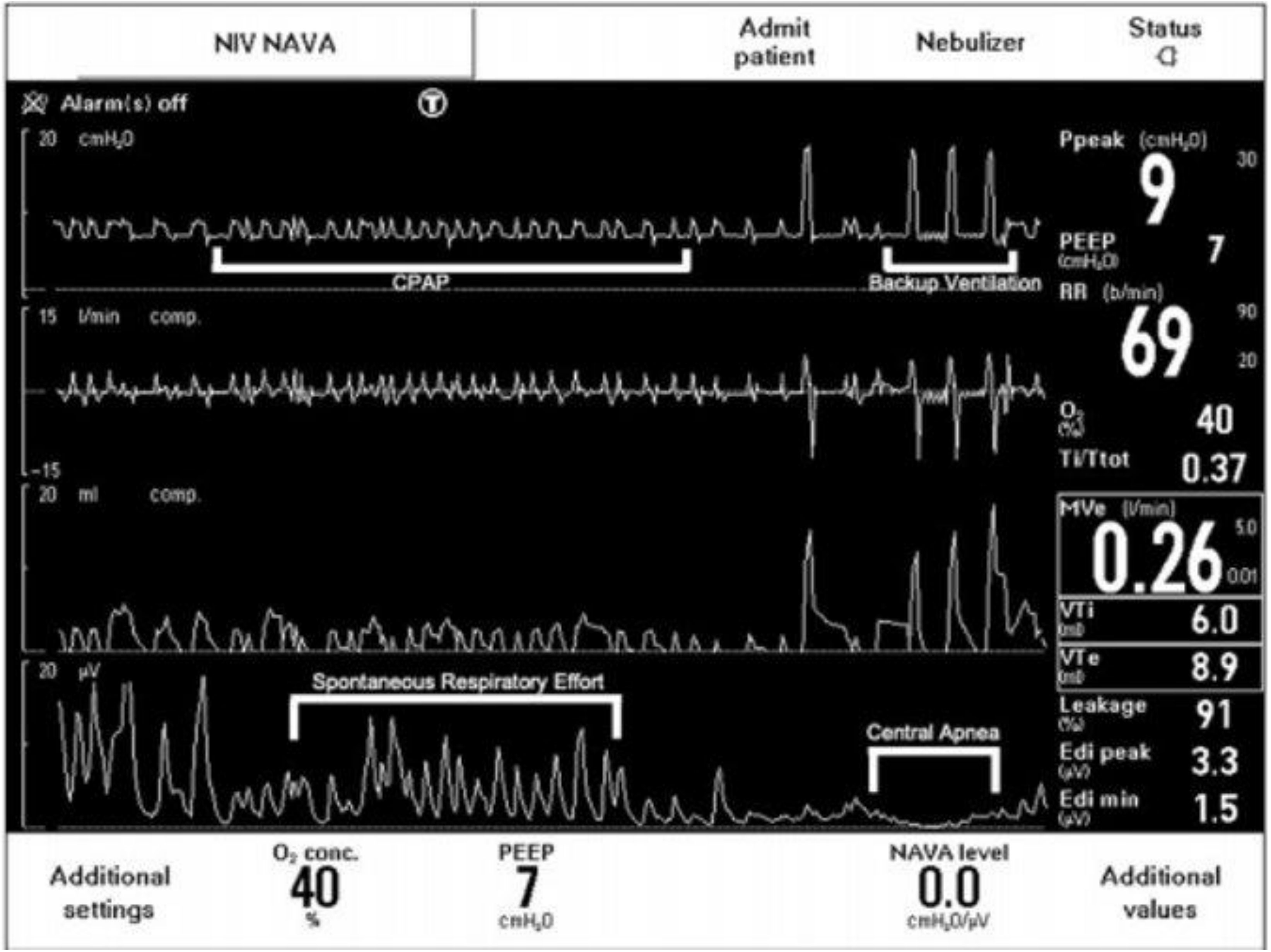
NAVA Level of 0 cmH2O/µV

- Apnea of Prematurity
  - Major challenge of NCPAP in neonates is frequent apnea.
  - With NAVA Level of 0 cmH2O/µV patient receives ventilatory support during clinically significant events (CSE).
    - •Apnea time
  - Ability to continue utilizing the Edi waveform as a respiratory vital sign and monitor WOB.
  - Great indicator of how the patient is tolerating NCPAP and if the clinician is unloading WOB properly.
  - **Noninvasive Only*



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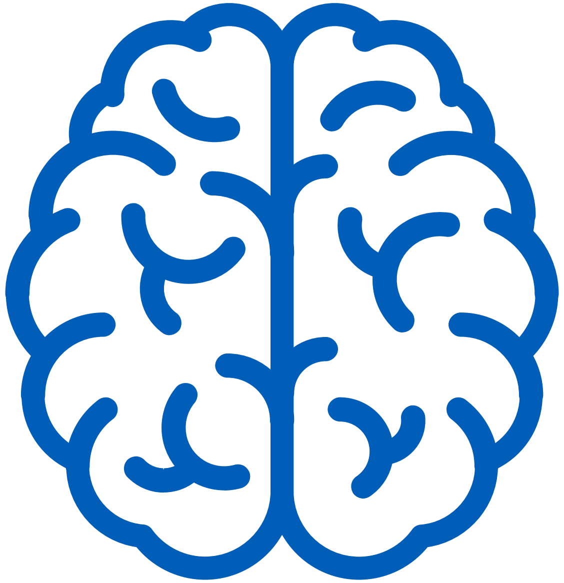
Diagnostic tool



Assess synchrony

Assess respiratory drive

Dx:

- Congenital central hypoventilation syndrome

Limitations/Cautions of NAVA

Uncontrollable or inappropriate respiratory drive/responses

Respiratory Failure

*Patients with high respiratory drive- high PIP-drive overrides protective reflexes?

- * Set upper pressure limit appropriately

Depressed drive- sedation or over support

Loss or absence of Edi signal

Check catheter placement

Possibility of central apnea

Contraindications

- Non-intact respiratory center, phrenic nerve, or neuromuscular junction
- Patient requiring heavy sedation or neuromuscular blockades
- Esophageal atresia
- A disease that prohibits neuromuscular transmission
- The presence of apnea*

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