The Basic Concept of NAVA & Edi

GETINGE

Breathing

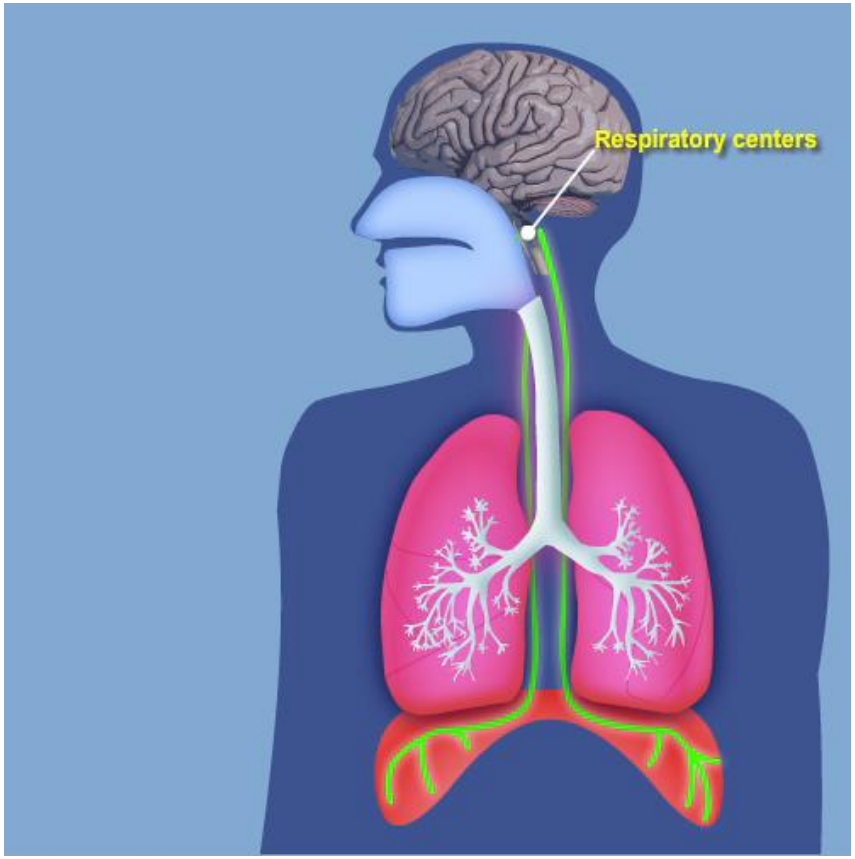
is regulated by the
respiratory centers

GETINGE

Breathing

Mechanism of spontaneous breathing

- Respiratory centers
- Phrenic nerve
- Diaphragm

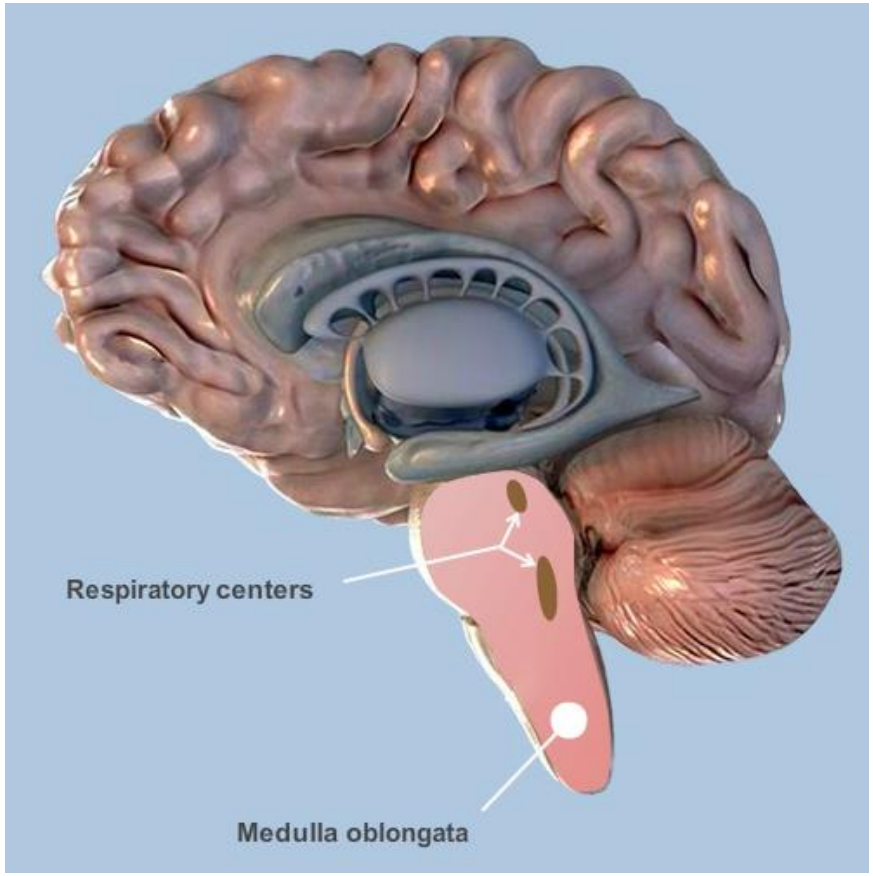


GETINGE

Breathing

The brain and the respiratory centers

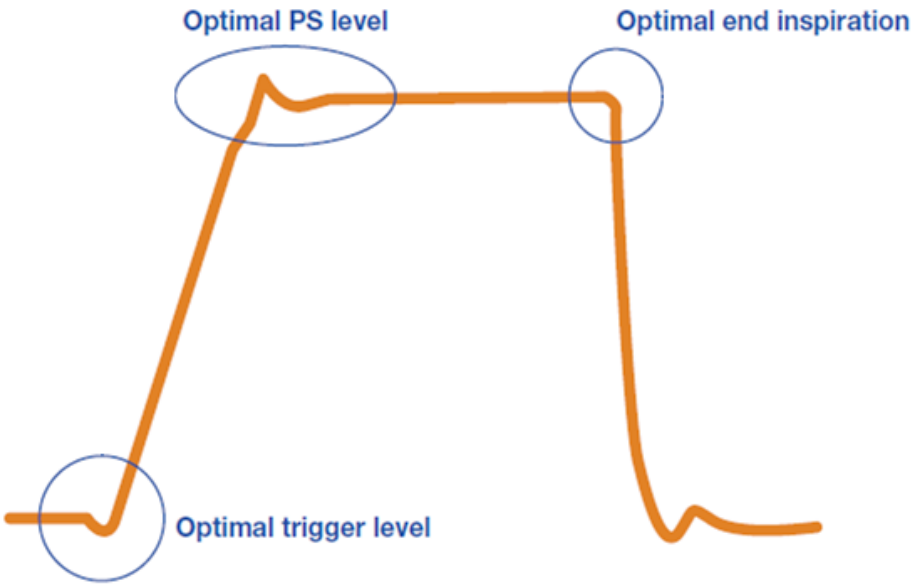
- Respiratory centers in Medulla oblongata
- Chemical receptors
- Mechanical receptors



Conventional ventilatory treatment

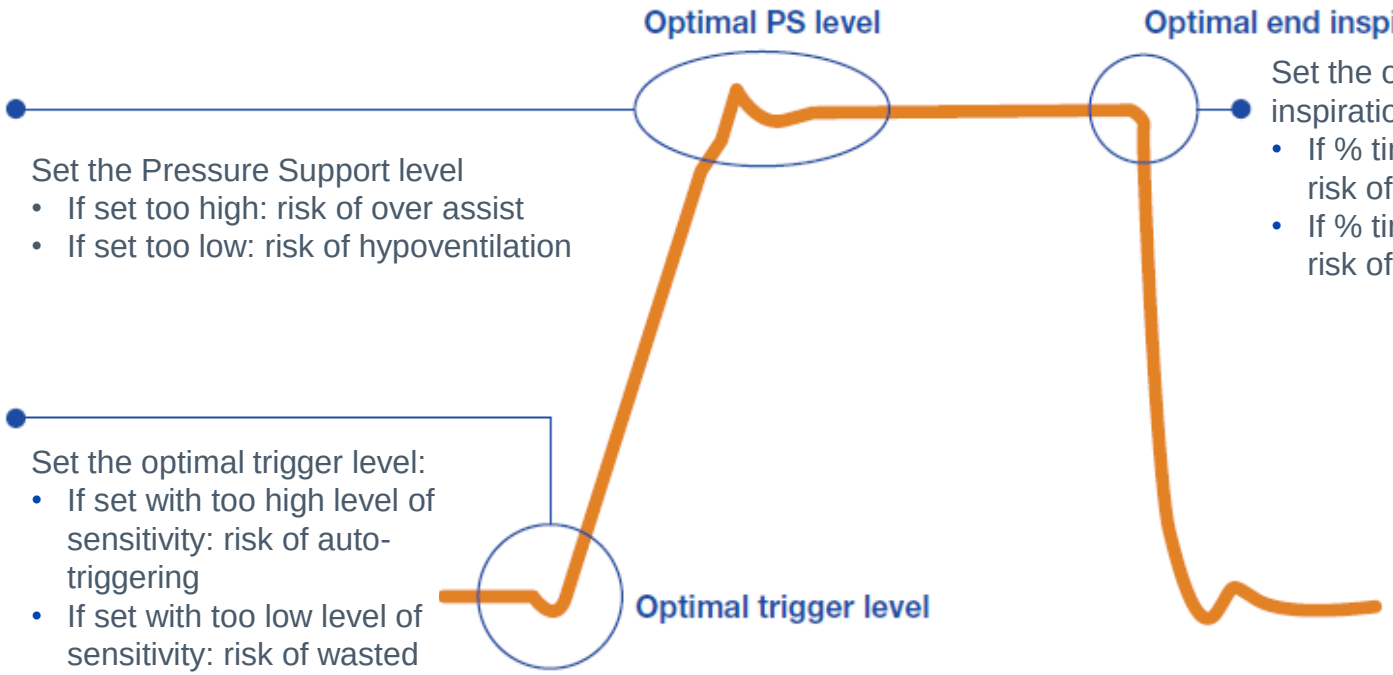
How to set supported modes

It is difficult to adjust settings in conventional supported modes



Conventional ventilatory treatment

What needs to be set in Pressure Support?



Set the Pressure Support level
- If set too high: risk of over assist
- If set too low: risk of hypoventilation

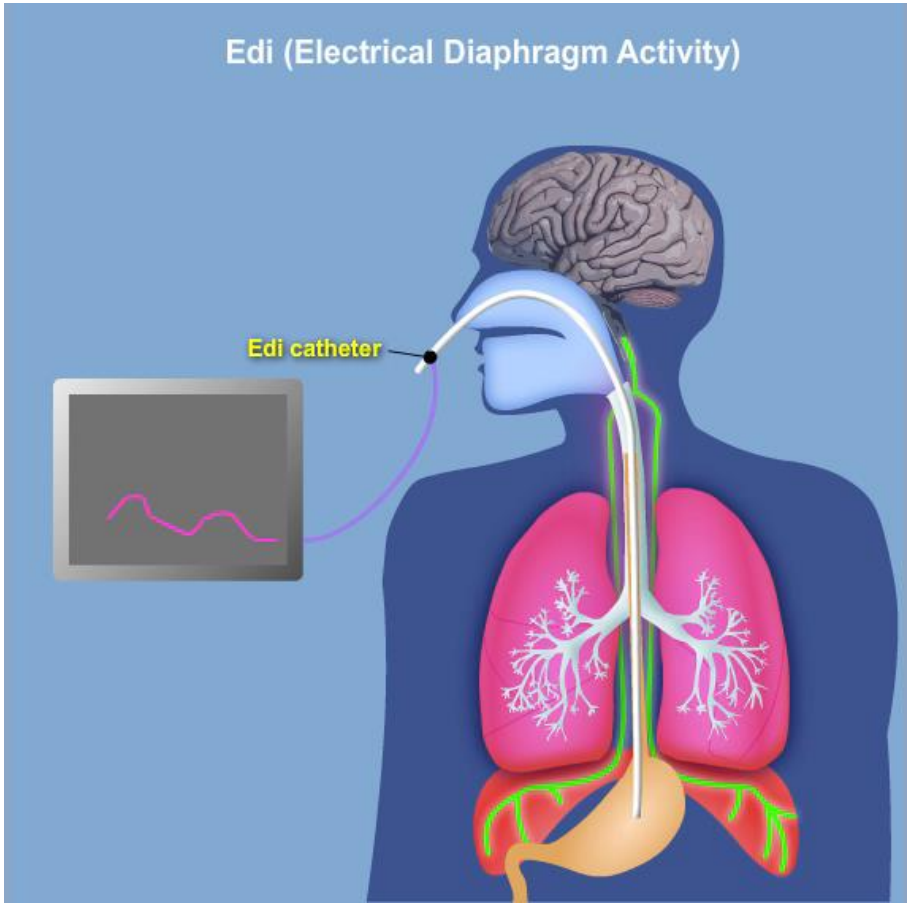
Set the optimal end inspiration (cycle off):
- If % timing is set too long: risk of asynchrony
- If % timing is set too short: risk of double triggering

Set the optimal trigger level:
- If set with too high level of sensitivity: risk of auto-triggering
- If set with too low level of sensitivity: risk of wasted effort

The Electrical Activity of the diaphragm

The respiratory vital sign

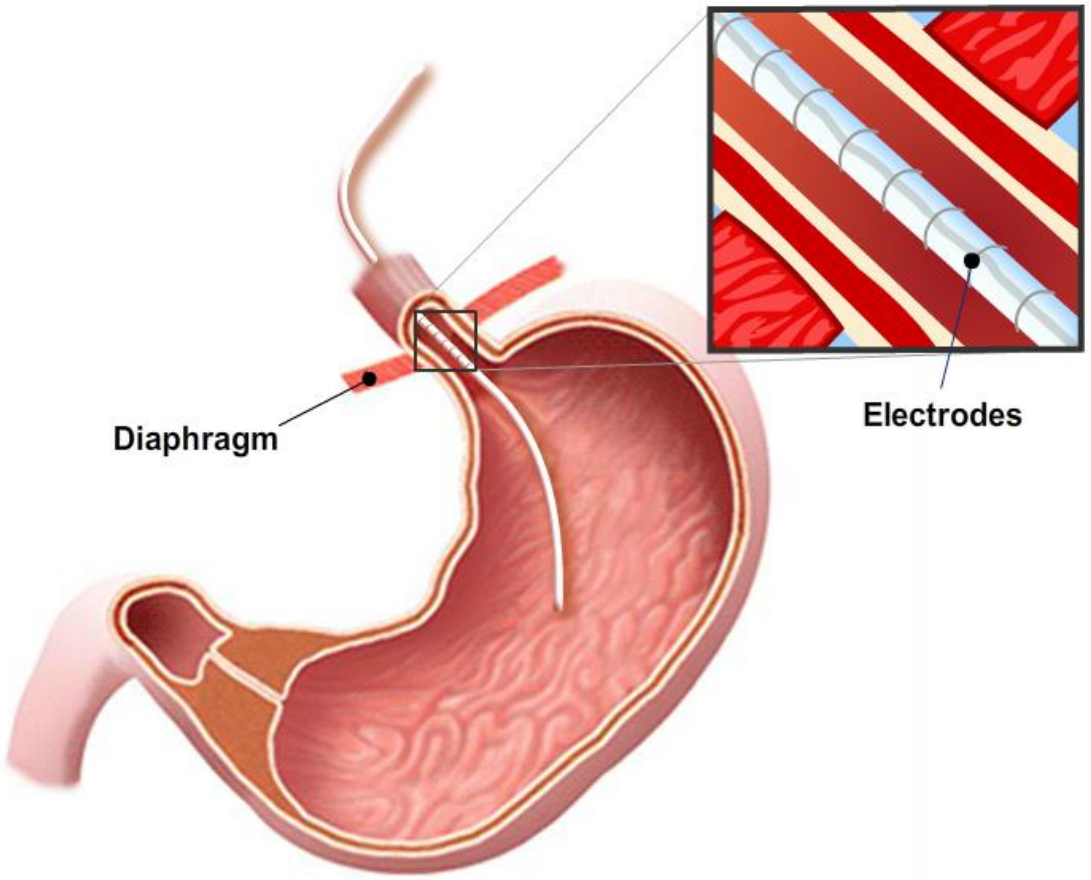
- The diaphragm is the main respiratory muscle
- Edi = patient´s respiratory drive
- The Edi is measured in microvolts (µV)



Edi

Capturing the Edi signal

- Nine electrodes
- Single use nasogastric tube
- Used for feeding

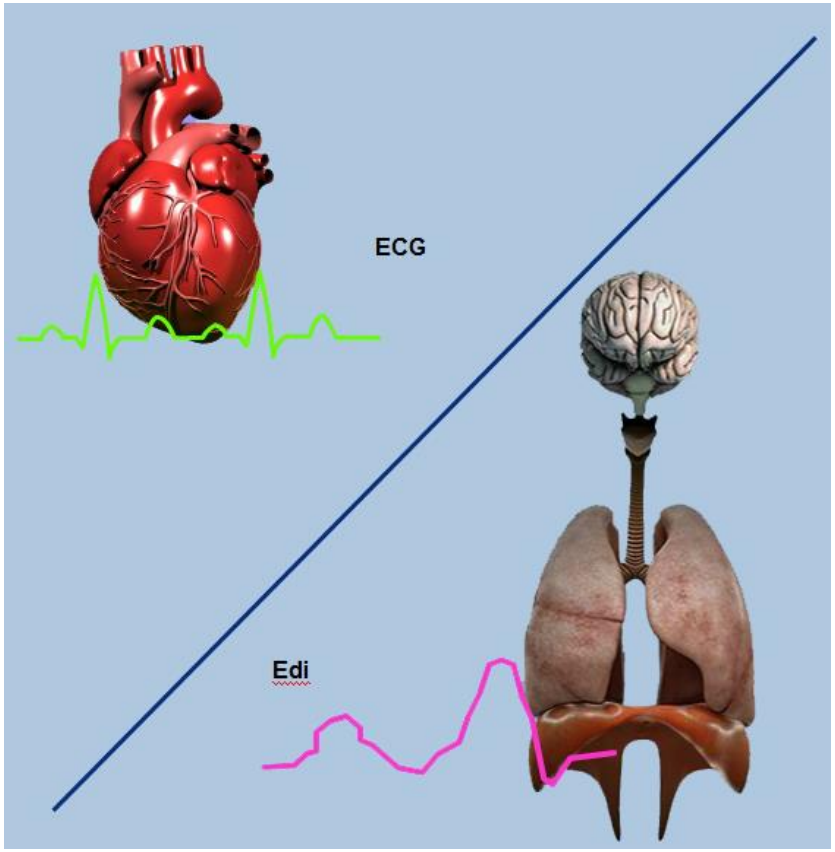


Electrical signal

ECG and Edi

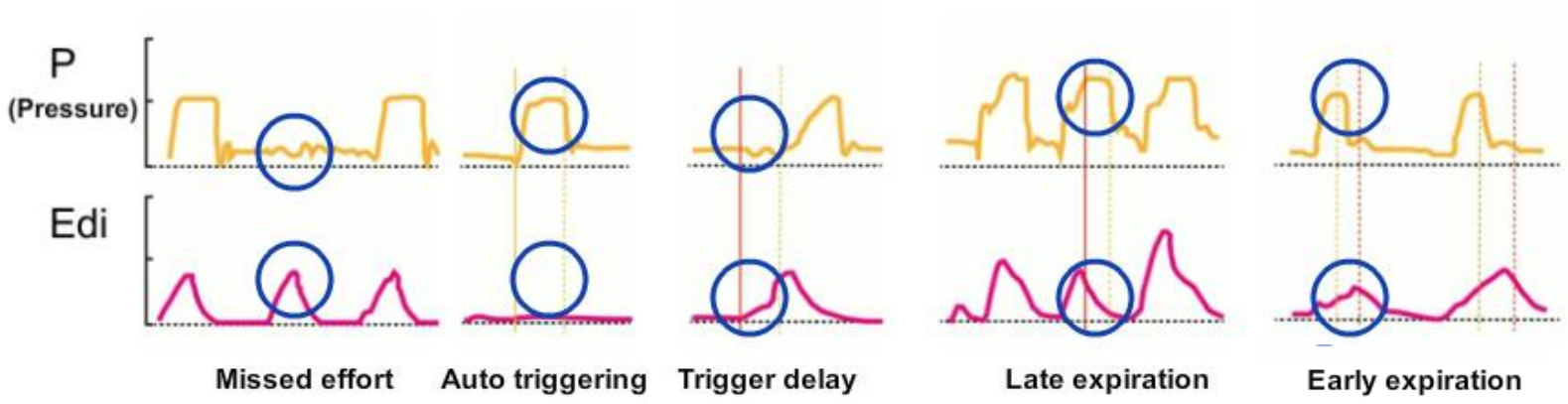
The diaphragm is the “heart” of the respiratory system designed to be continuously active

The Edi signal is the vital sign of respiration, just like the ECG is the vital sign of circulation



Edi

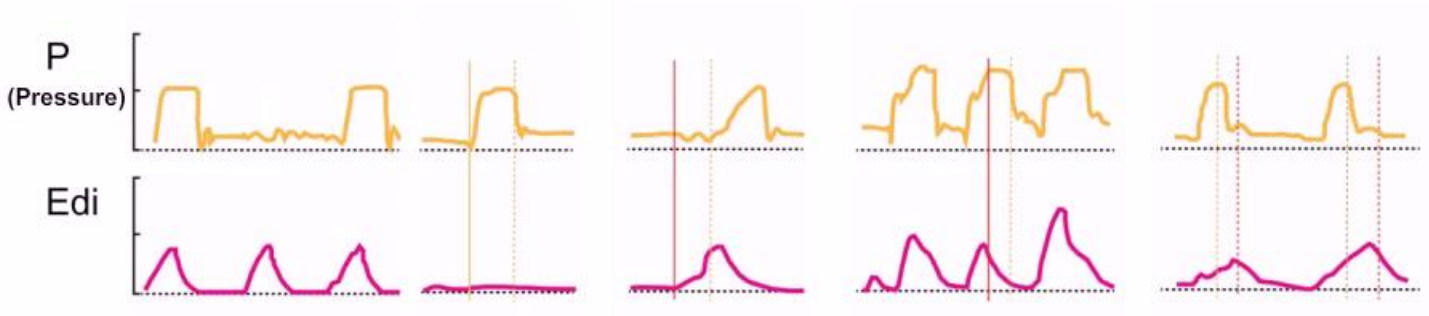
Use to detect different asynchronies



Edi

Asynchrony

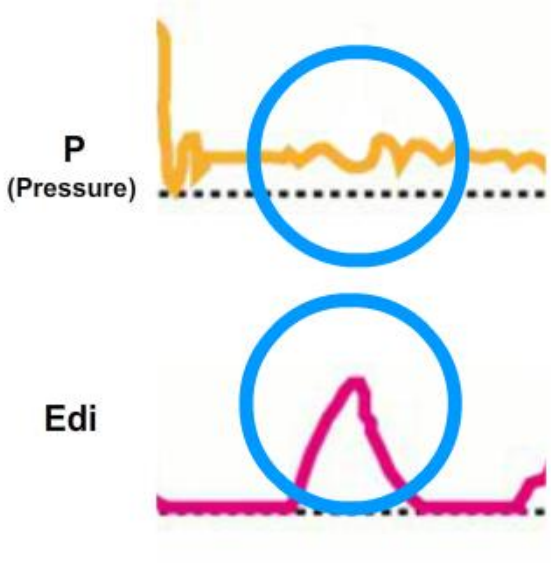
One out of four intubated patients suffers from severe asynchrony, resulting in a longer stay[1]



Asynchrony

Wasted effort

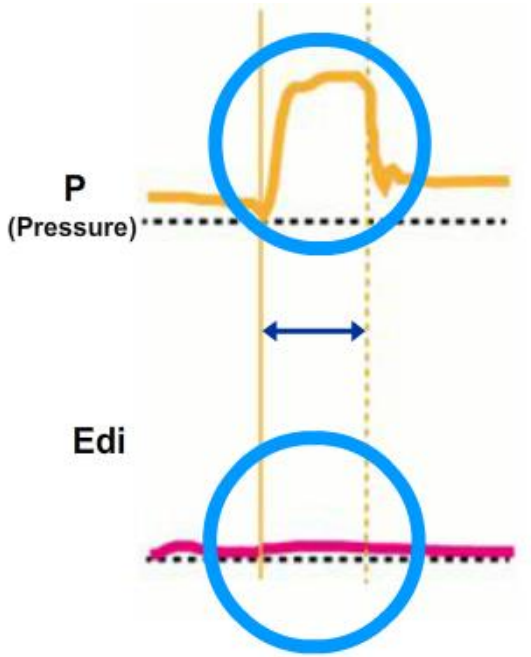
1 With wasted effort (ineffective triggering), the patient has an inspiratory effort and the ventilator fails to trigger



Asynchrony

Auto-triggering

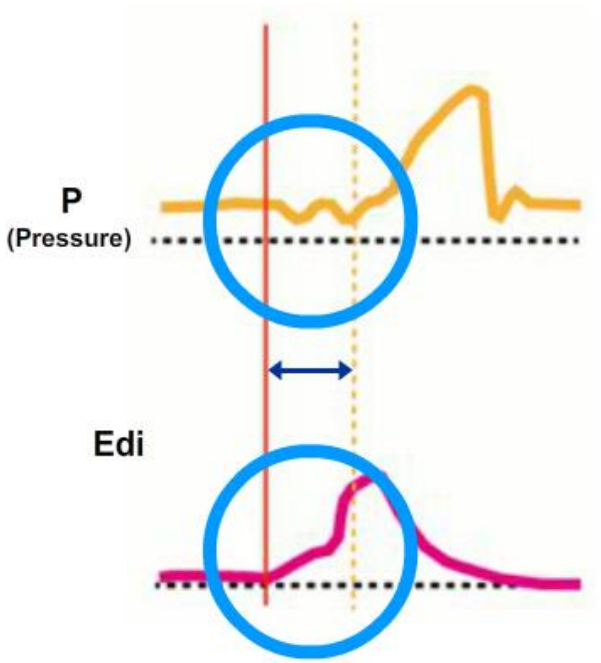
2 Assist is initiated from the ventilator, but there is no inspiratory effort from the patient.



Asynchrony

Delayed triggering

3 The ventilator starts delivering assist after patient effort.

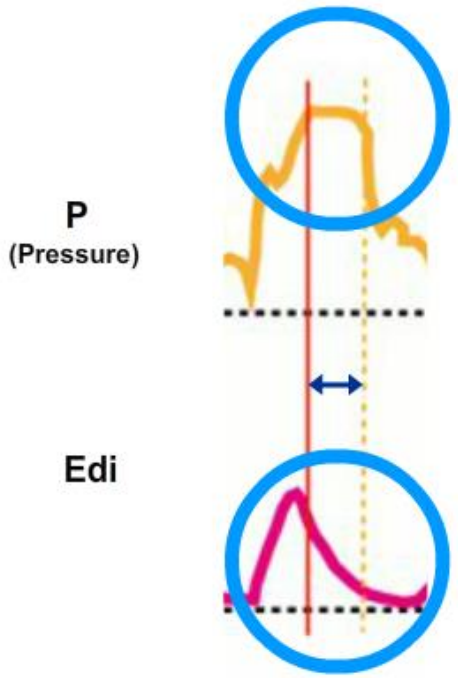


Asynchrony

Delayed end inspiration

4

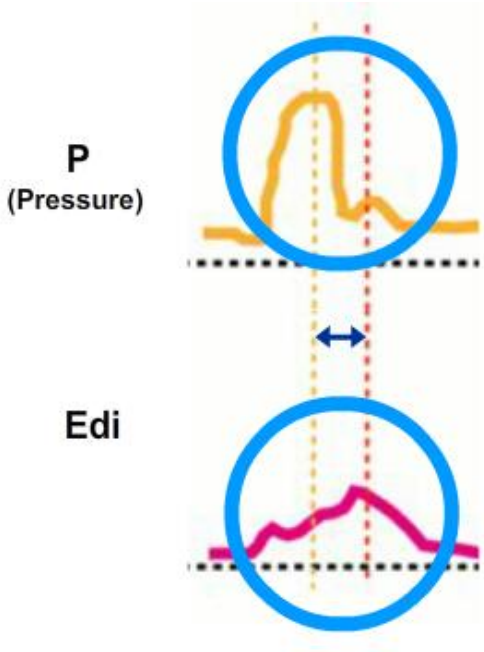
When the patient has finished inspiration and switches to expiration, the ventilator continues to deliver assist during expiration.



Asynchrony

Premature end inspiration

5 The ventilator ends the breath before the end inspiration of the neural inspiration (the Edi).

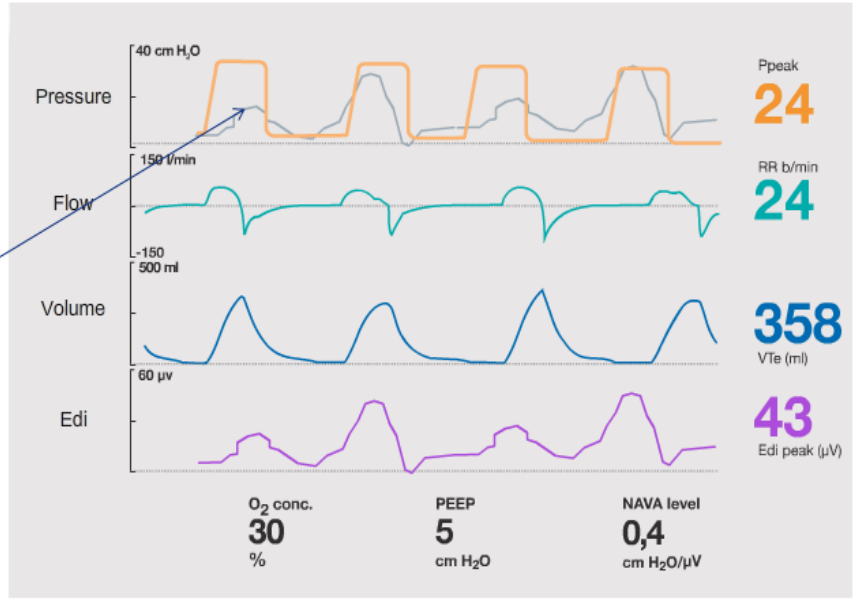


Edi

A better picture of breathing effort

The overlay of the Edi signal and pressure curves illustrate how the ventilator is in synchrony with the patient.

The Edi can give a picture of the breathing effort in any mode of ventilation, breath by breath.



NAVA

Neurally Adjusted Ventilatory Assist (NAVA)

In the NAVA® ventilation mode, the Edi signal controls time and level of assist.

Synchrony

Patient determines timing and assist of each breath

With NAVA, the patient determines time and assist levels. The clinician sets PEEP and level of support (NAVA level). As the patient determines timing and assist within each breath, different pressure waves are seen with NAVA, allowing the patient to take a variation of breaths (play video below).

Time synchrony

Assist synchrony

Assist pressure

Edi signal

NAVA mode

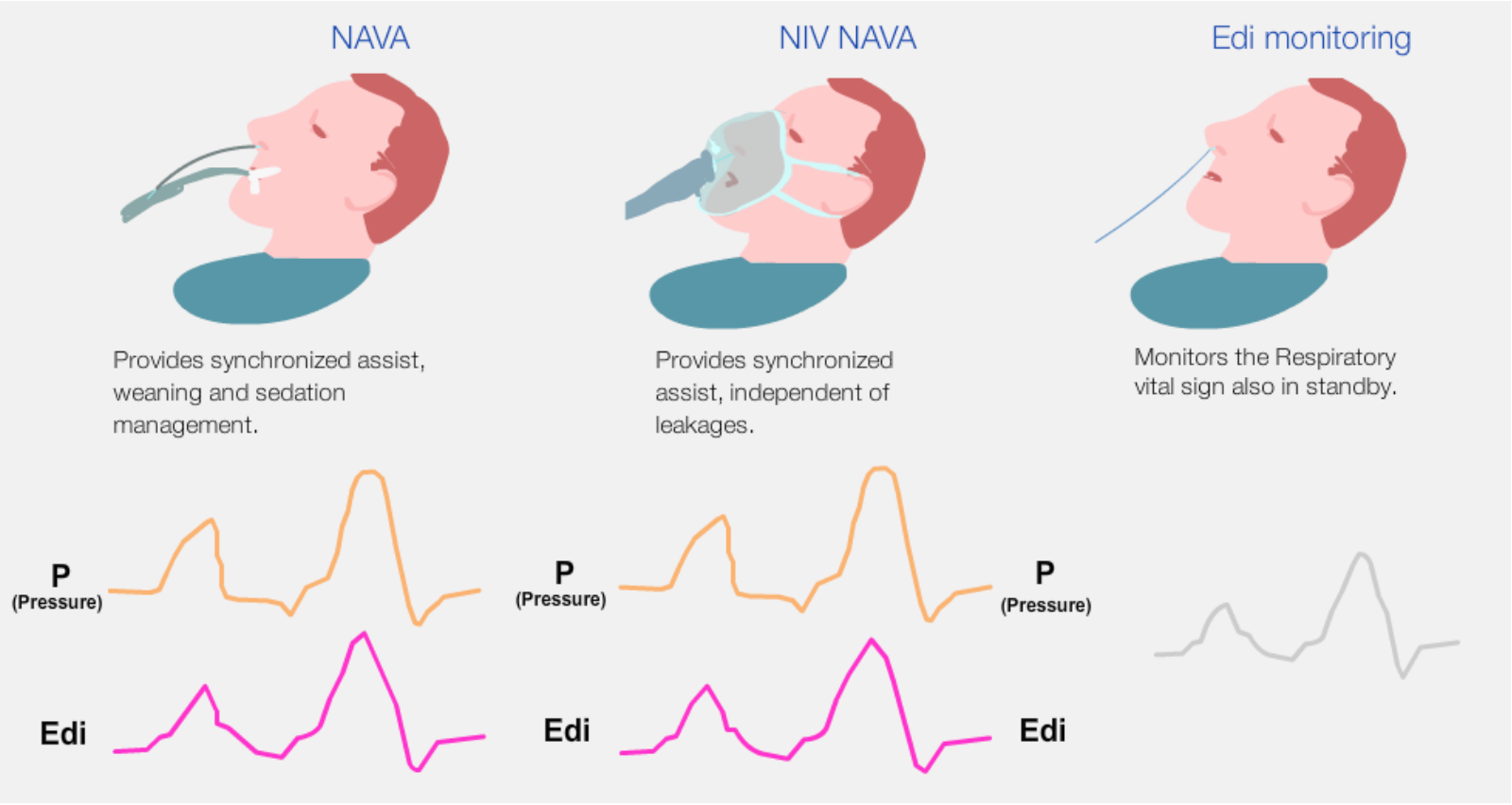
The Edi signal

In NAVA, the breath support is controlled by the patient's needs/demands.

Both NAVA and NIV NAVA deliver ventilatory assist in proportion to and in synchrony with the patient's Edi signal.

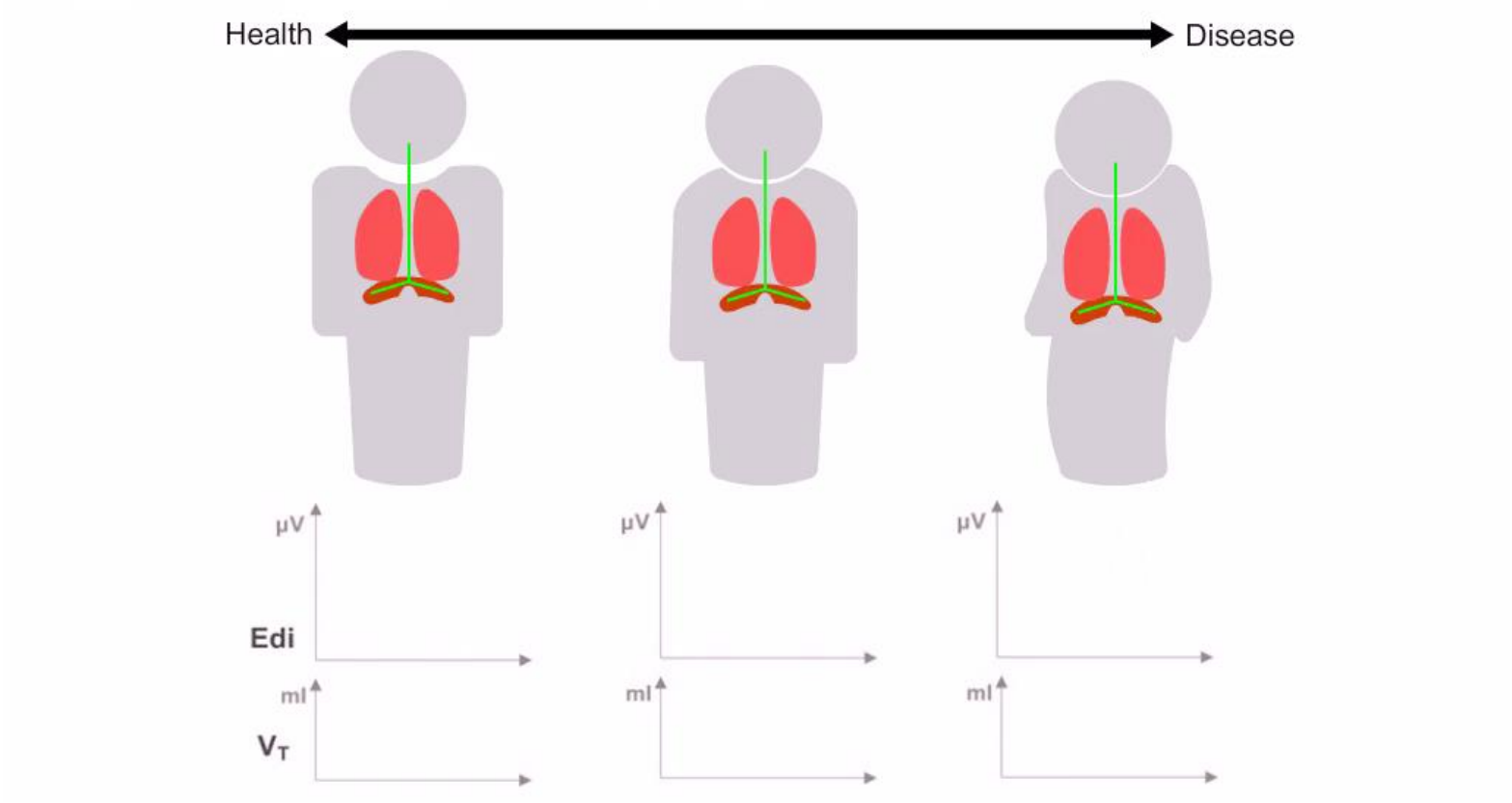
Edi catheter

Can be used for NAVA, NIV NAVA and Edi monitoring



NAVA

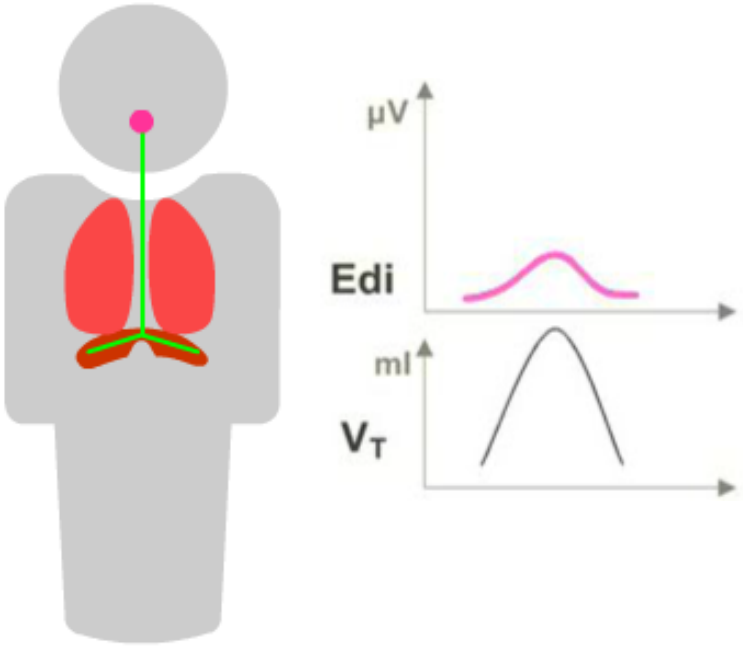
NAVA delivers the tidal volumes that the patient wants



NAVA

NAVA delivers the tidal volumes that the patient wants

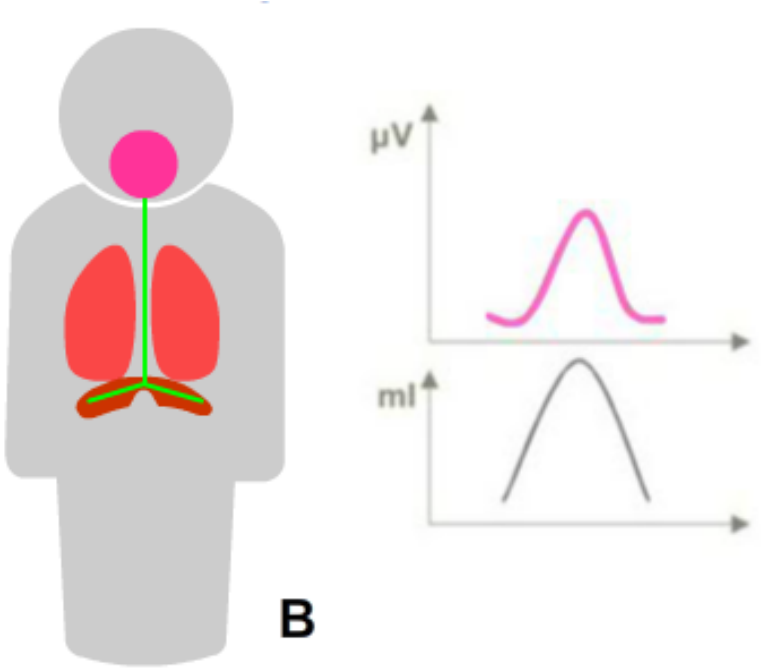
The efficiency of the respiratory muscles determines the degree of the respiratory centers output (Edi).



NAVA

NAVA delivers the tidal volumes that the patient wants

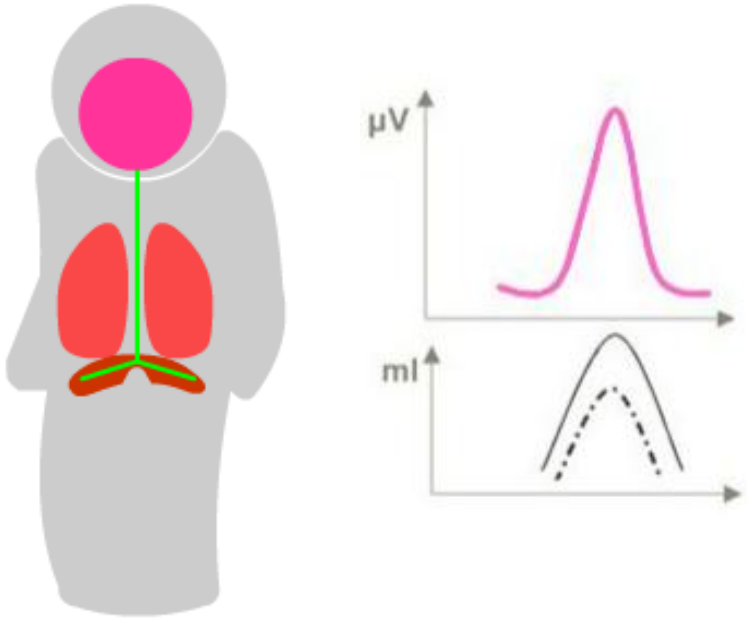
In disease, the muscle may not perform efficiently, leading to an increased output from the respiratory centers (high Edi) and recruiting additional muscle fibers in the diaphragm.



NAVA

NAVA delivers the tidal volumes that the patient wants

In severe lung disease, the increased signal, which is seen in e.g. COPD and Acute Respiratory Failure patients, indicates that a large part of the muscular reserve is used. Up to 40% of the maximum capacity of the diaphragm may be used by COPD patients during resting breathing.



Edi, NAVA and NIV NAVA

Clinical benefits

Edi

Allows you to monitor and safeguard the patient's diaphragm activity.[1,2]

Guides the weaning process.[3]

Helps to prevent muscular exhaustion during weaning trials even after extubation.[4]

NAVA

Assures that breathing efforts from all patient categories are responded to.[5,6,7]

Promotes lung protective spontaneous breathing.[8,9,10]

Promotes higher diaphragmatic efficiency[11,12] and fewer periods of over- and under-assist.[13,14]

Improves patients' ICU experiences by reducing sedation and raising comfort scores.[15,16,17]

Improves sleep quality.[18,19]

NIV NAVA

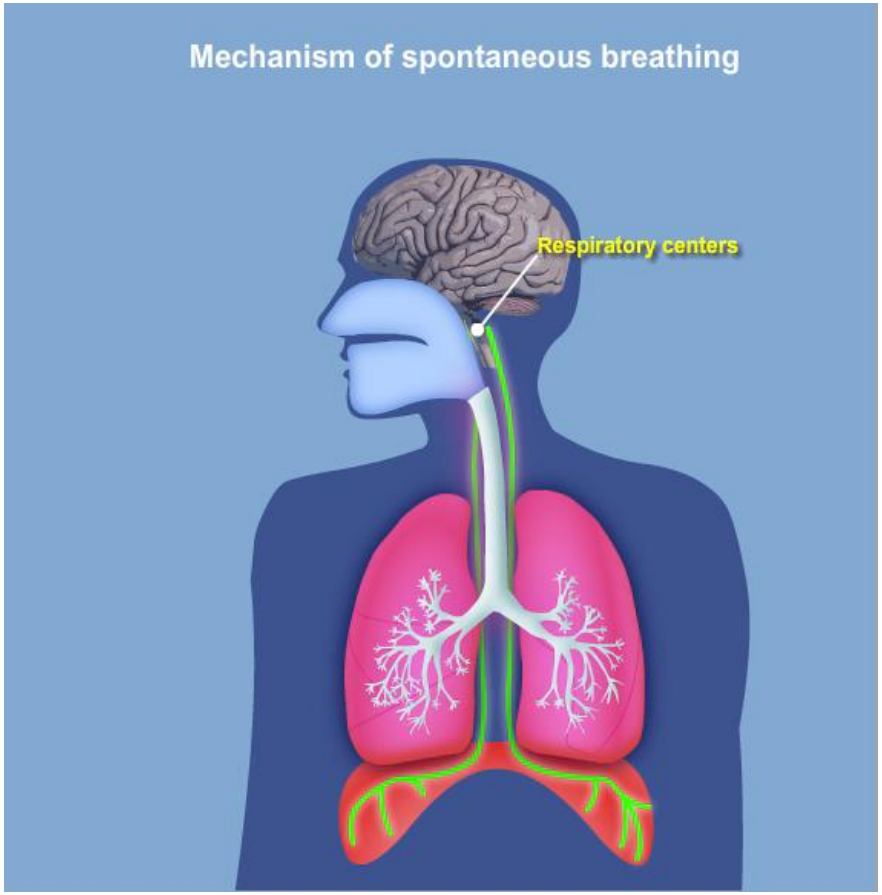
Is independent of leakage in patient interfaces and may prevent respiratory failure and intubation.[5,6,7]

NAVA Set-up

NAVA and NIV NAVA

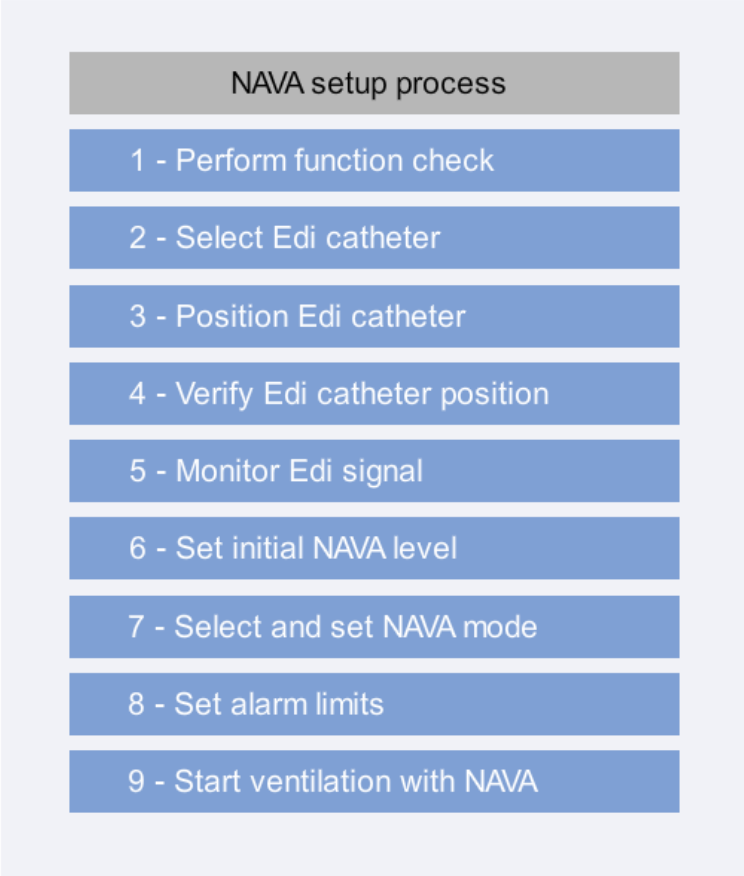
Patients

- Intended for respiratory support, monitoring and treatment of neonatal, pediatric and adult patients.
- Improves synchrony between the ventilator system and patient when the electrical signal from the brain to the diaphragm is active.
- Can be used on all patients with no contraindication for insertion/exchange of a nasogastric tube.



NAVA

Workflow



NAVA workflow

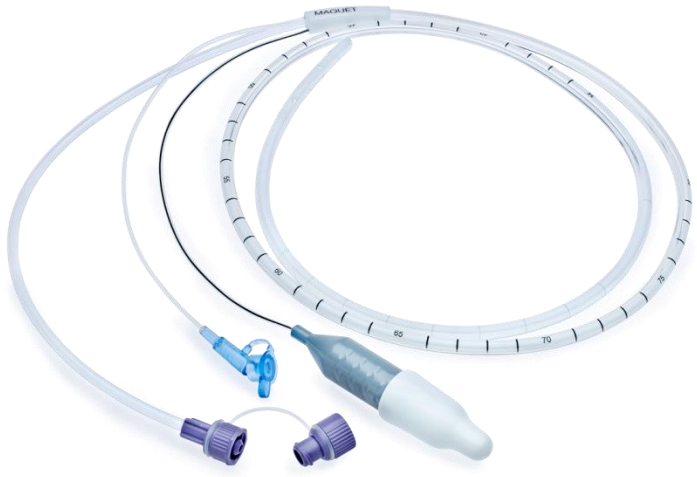
Function check

Insert the Edi module into the ventilator. Connect the Edi cable to the Edi module. Perform Edi module function check.

NAVA Workflow

Select Edi catheter

- The Edi catheter size for the patient based on the patient's height and/or weight
- The Edi catheter is for single use only
- Each Edi catheter may be used for up to 5 days



Patient height	Patient weight	Edi catheter size
> 140 cm	-	16 Fr 125 cm
75 – 160 cm	-	12 Fr 125 cm
> 140 cm	-	8 Fr 125 cm
45 – 85 cm	-	8 Fr 100 cm
< 55 cm	1.0 – 2.0 kg	8 Fr 50 cm
< 55 cm	1.0 – 2.0 kg	6 Fr 50 cm
< 55 cm	0.5 – 1.5 kg	6 Fr 49 cm

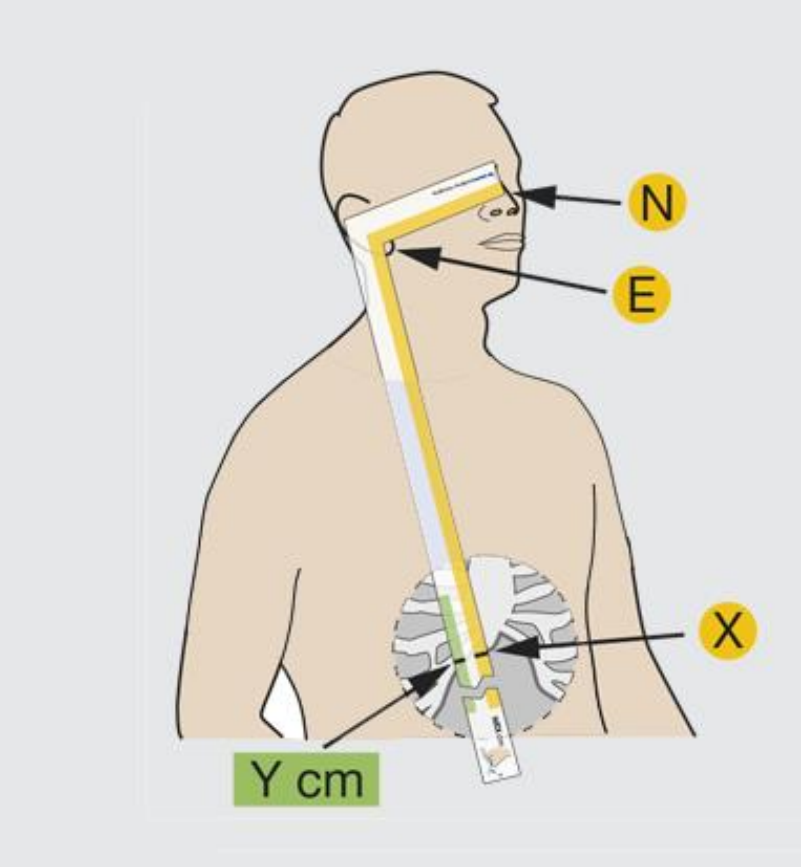
NAVA Workflow

Measure NEX (Nose, Ear, Xiphoid)

To measure Nose to Ear to Xiphoid (NEX) use the tape measure delivered with the Edi catheter package.

Choose the side of the tape:

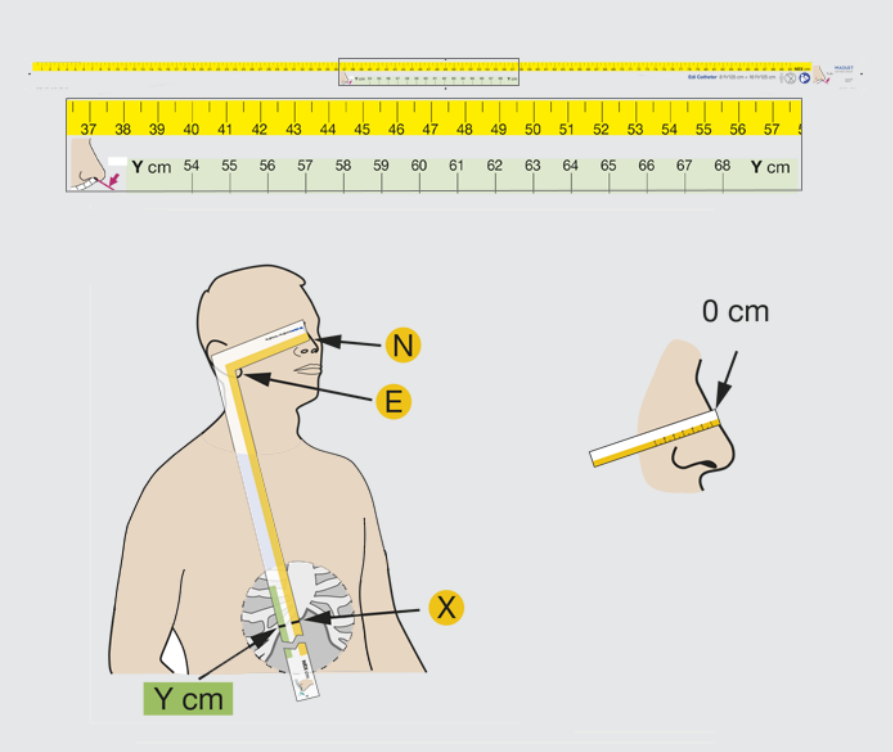
- one side is for oral (yellow/pink)
- and one for nasal (yellow/green) insertion



NAVA Workflow

Measure NEX (Nose, Ear, Xiphoid)

1. Measure from the bridge of the nose (N) to the earlobe (E) and then to the xiphoid (X) with the provided tape measure.
2. Read the corresponding Y value on the tape.



NAVA Wworkflow

Calculating the insertion distance

Calculating the insertion distance (Y) for the Edi catheter.

Note in SERVO-U and SERVO-n, there is a calculation tool.

Insertion distance Y for nasal insertion		Insertion distance Y for oral insertion	
Fr/cm	**Calculation of Y**	**Fr/cm**	**Calculation of Y**
16 Fr 125 cm	NEX cm x 0.9 + 18 = Y cm	16 Fr	NEX cm x 0.8 + 18 = Y cm
12 Fr 125 cm	NEX cm x 0.9 + 15 = Y cm	12 Fr	NEX cm x 0.8 + 15 = Y cm
8 Fr 125 cm	NEX cm x 0.9 + 18 = Y cm	8 Fr 125 cm	NEX cm x 0.8 + 18 = Y cm
8 Fr 100 cm	NEX cm x 0.9 + 8 = Y cm	8 Fr 100 cm	NEX cm x 0.8 + 8 = Y cm
8 Fr 50 cm	NEX cm x 0.9 + 3.5 = Y cm	8 Fr 50 cm	NEX cm x 0.8 + 3.5 = Y cm
6 Fr 50 cm	NEX cm x 0.9 + 3.5 = Y cm	6 Fr 50 cm	NEX cm x 0.8 + 3.5 = Y cm
6 Fr 49 cm	NEX cm x 0.9 + 2.5 =Y cm	6 Fr 49 cm	NEX cm x 0.8 + 2.5 = Y cm

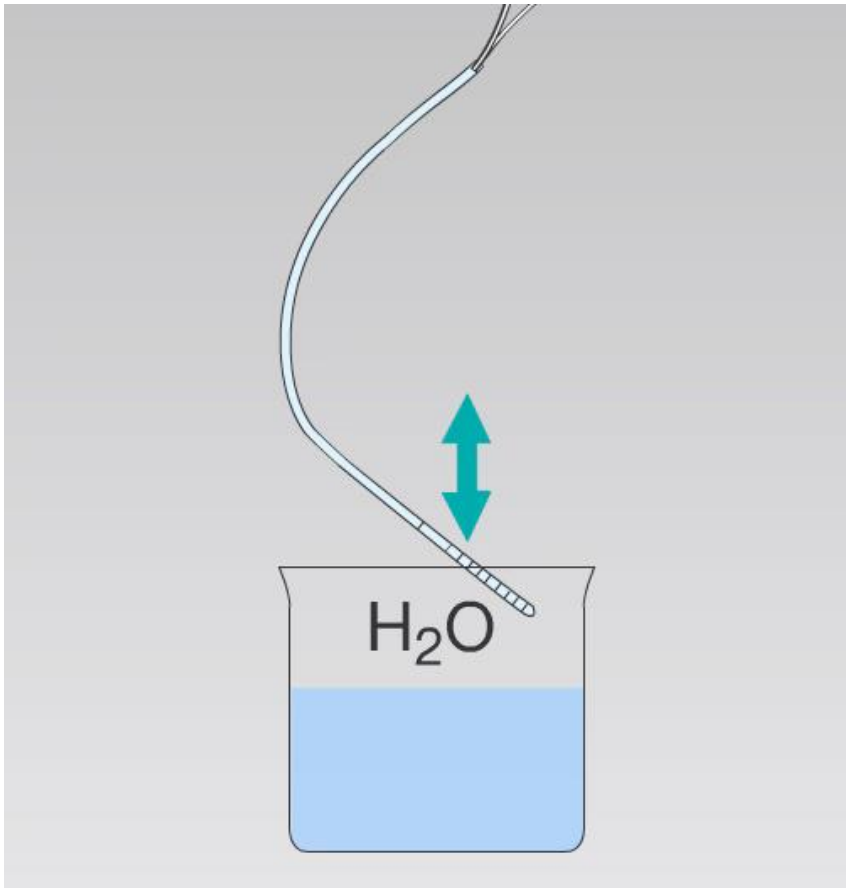
NAVA Workflow

Insert the Edi catheter

Dip the Edi catheter in water

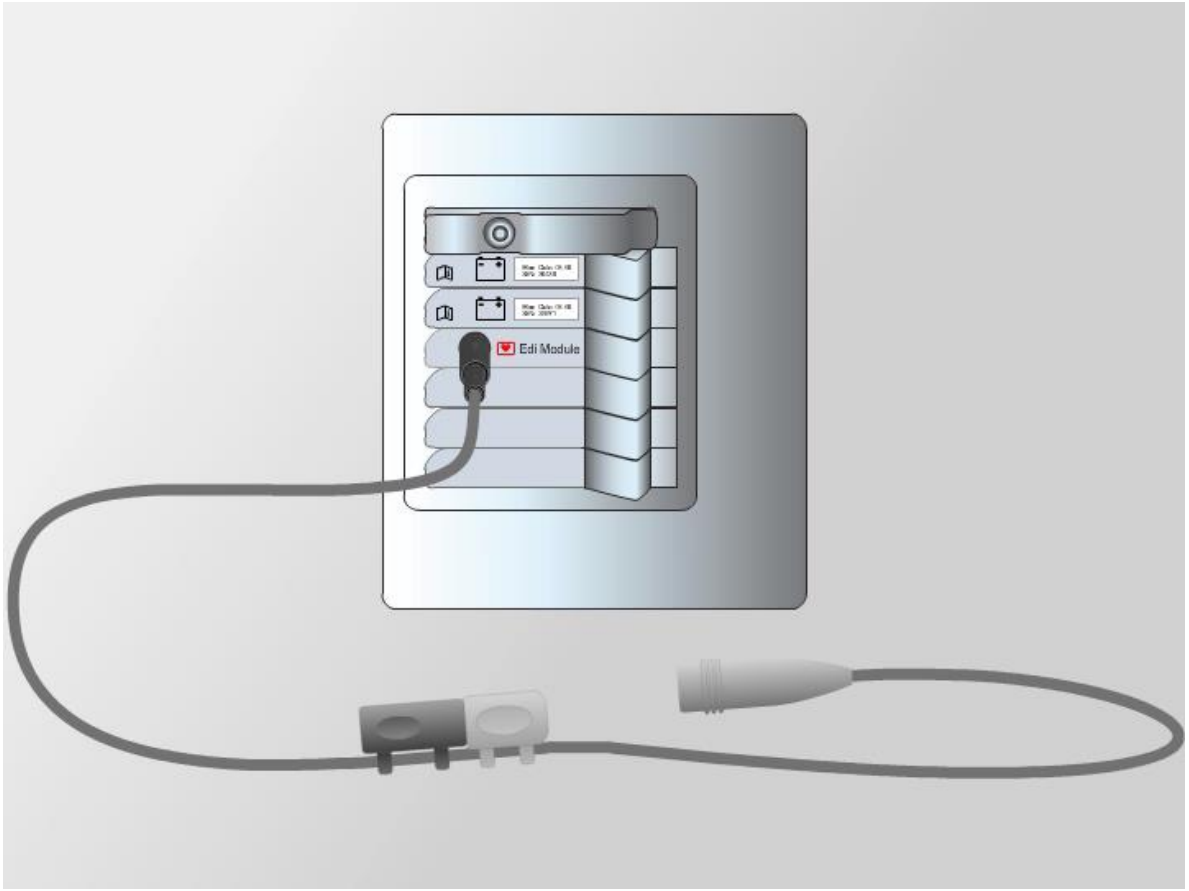
The distal part of the catheter has a coating which is activated upon contact with water to ease insertion.

Like an ordinary feeding tube, the Edi catheter is placed in the esophagus.



NAVA Workflow

Connect the Edi catheter to Edi cable

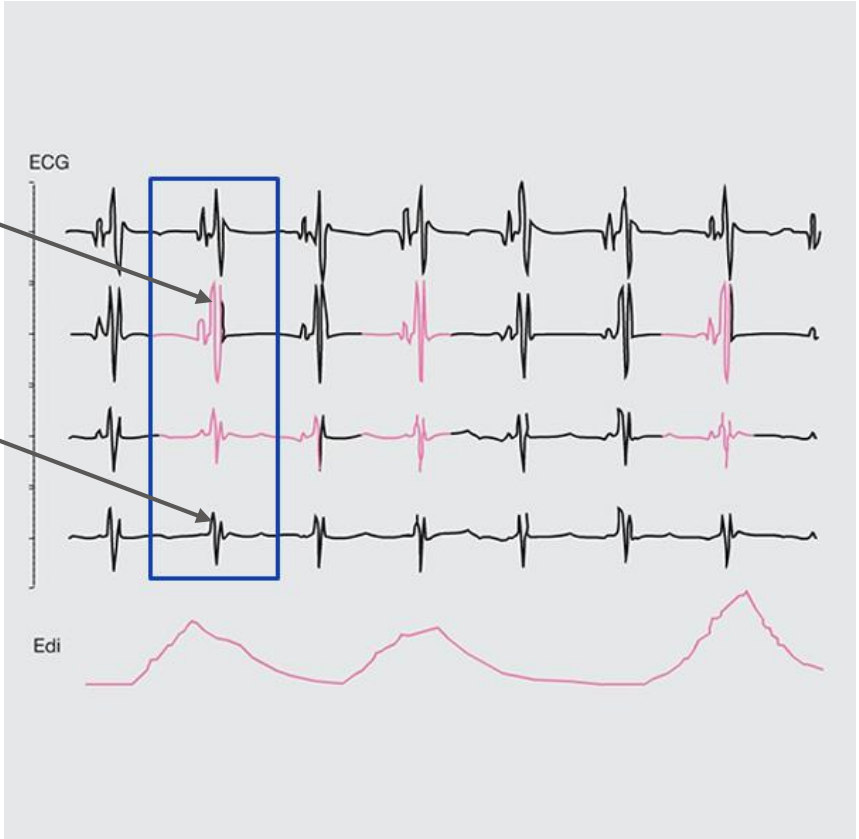


NAVA Workflow

Verify the Edi catheter position

QRS should be present in all four ECG leads. Ideally, P waves should only be present in the upper leads.

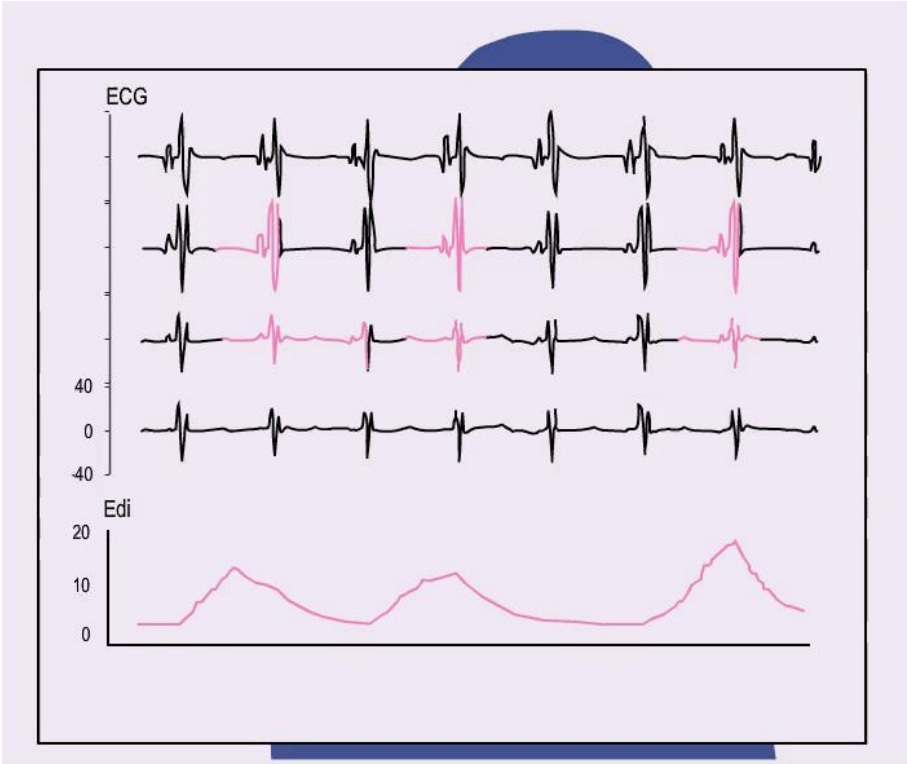
P waves should also gradually decrease and not be present in the two lower leads as the electrodes pass the diaphragm.



NAVA Workflow

Verify the Edi catheter position

The Edi catheter is correctly positioned if the second and third leads are highlighted in pink and the Edi signal is present.

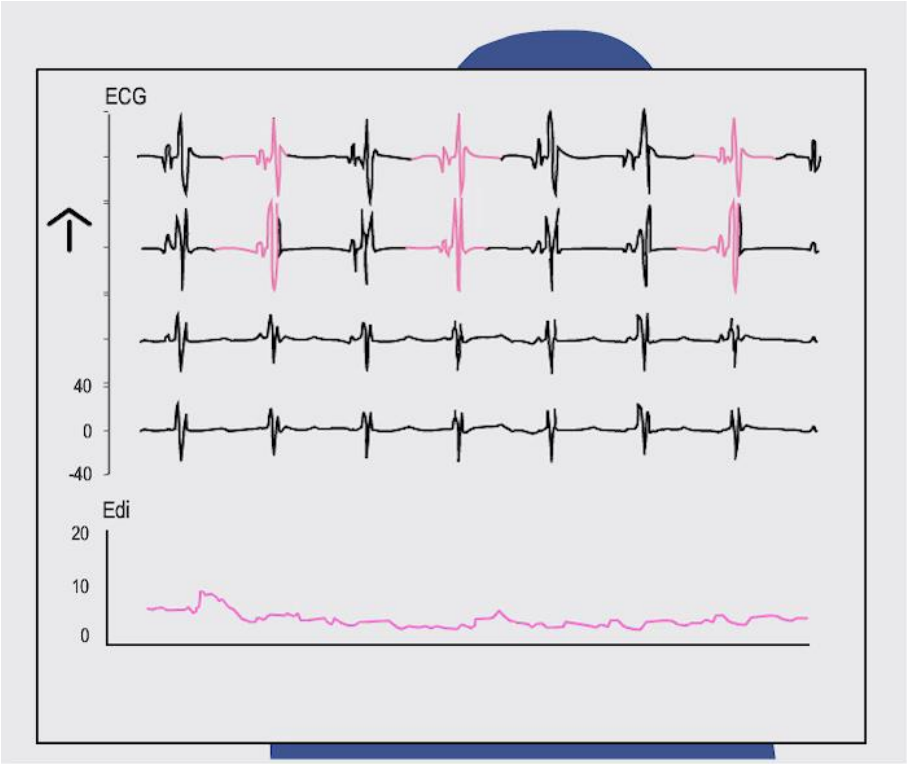


NAVA Workflow

Adjust position - Edi catheter too far in

If the upper leads are highlighted, gently pull out the Edi catheter until the pink highlight appears in the center:

- Too deep, pull out slightly

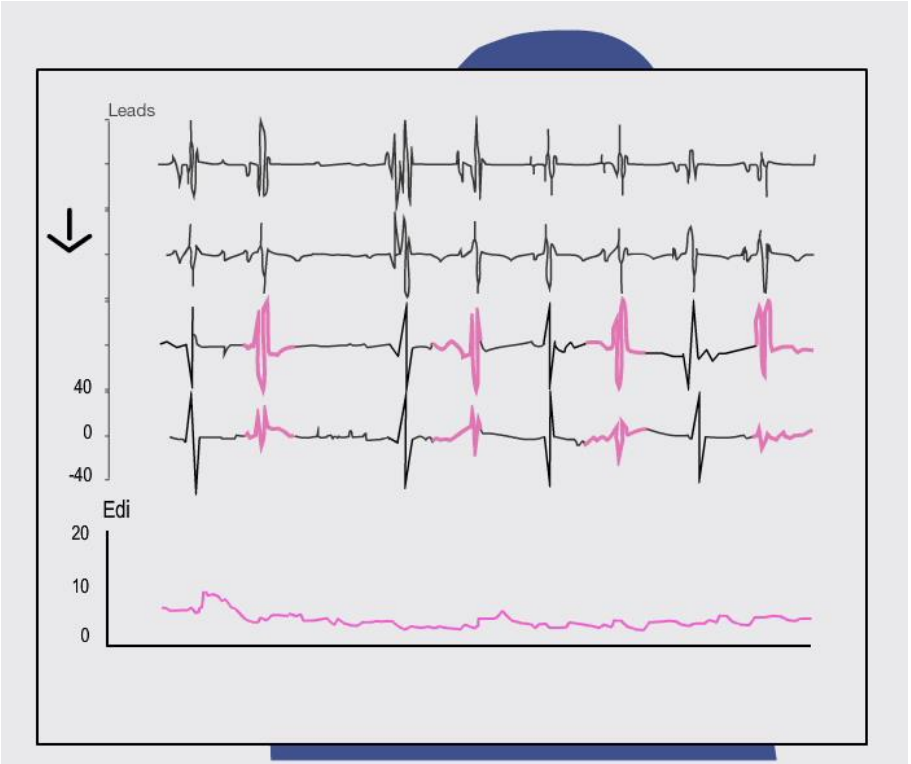


NAVA Workflow

Adjust position - Edi catheter too far out

If the bottom leads are highlighted, insert the Edi catheter further until the pink highlight appears in the center:

- Too shallow, insert further

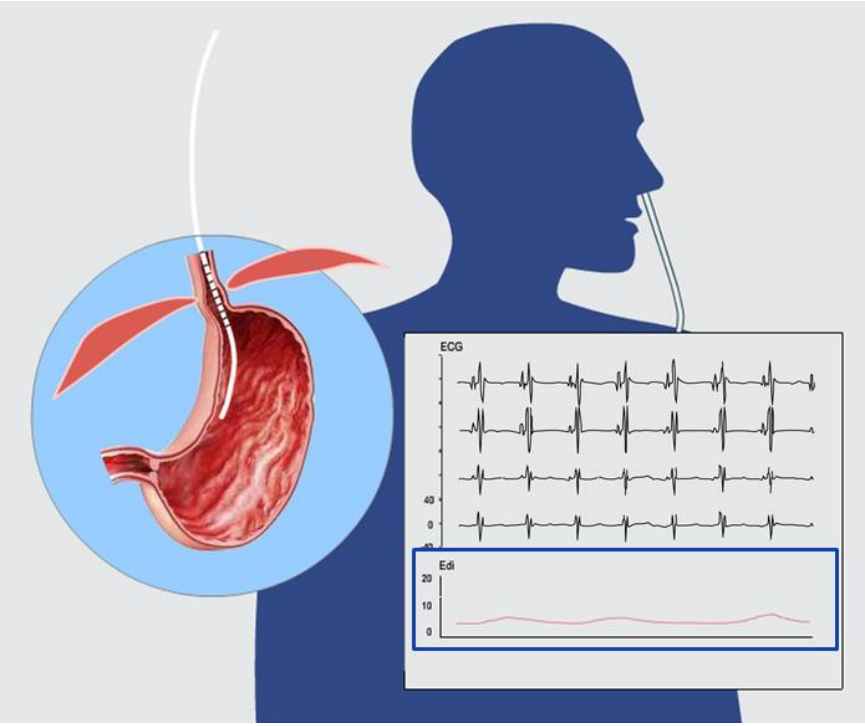


NAVA Workflow

Evaluate the Edi signal

A low or absent Edi signal may be due to the following:

- High sedation level
- Patient over assisted
- Edi catheter out of position
- Phrenic nerve injury

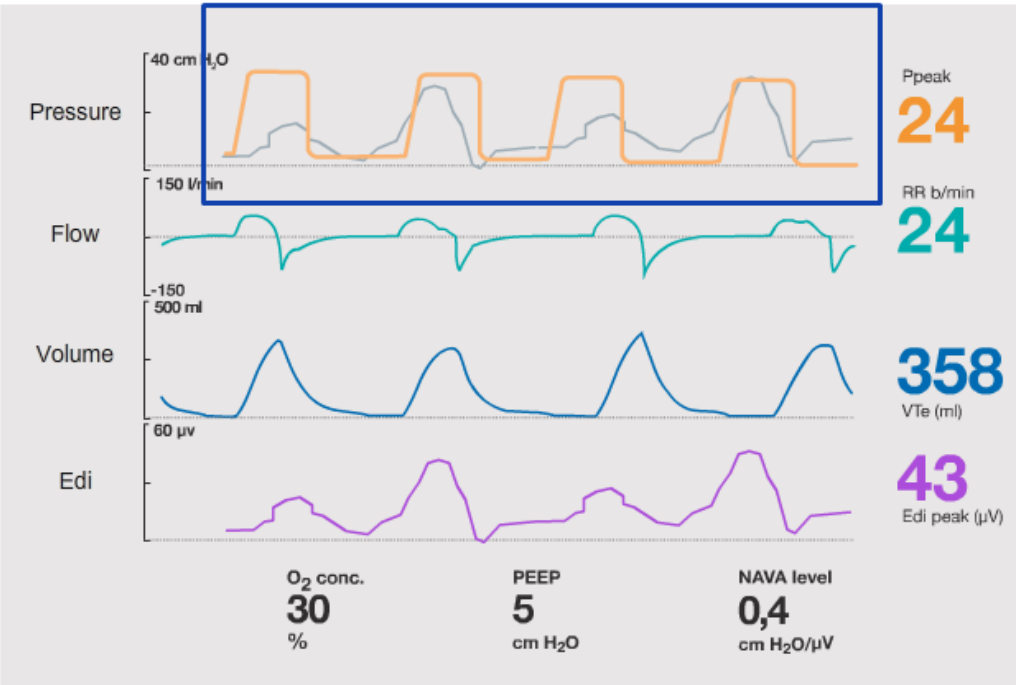


NAVA Workflow

Monitor the Edi signal

The yellow curve is the actual pressure delivery.

The gray curve is an estimation of the pressure delivered (based on actual Edi and NAVA levels).

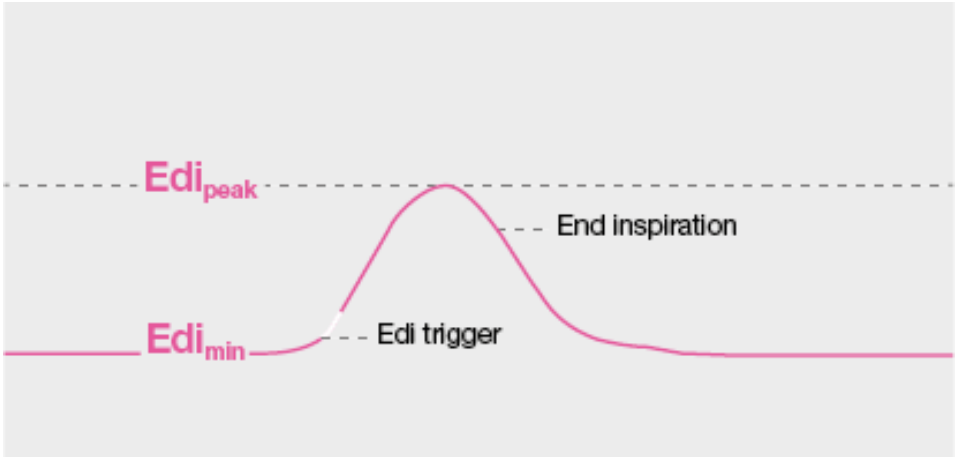


Select and set NAVA mode

Numerical values

Edi peak: Reflects the work the diaphragm has to perform for each breath.

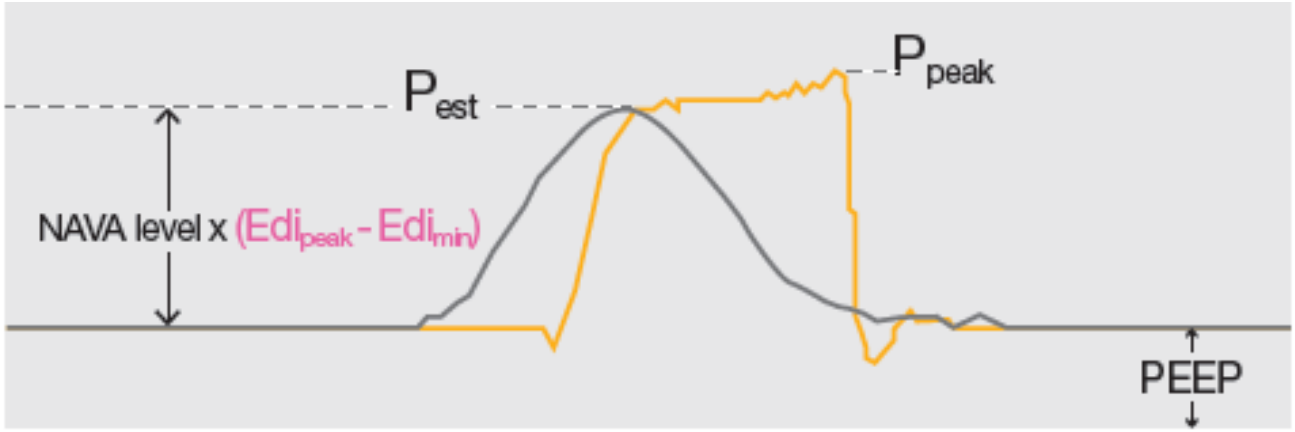
Edi min: Shows the baseline level of the resting diaphragm between contractions. The higher Edi min, the more tonic the diaphragm is.



Select and set NAVA mode

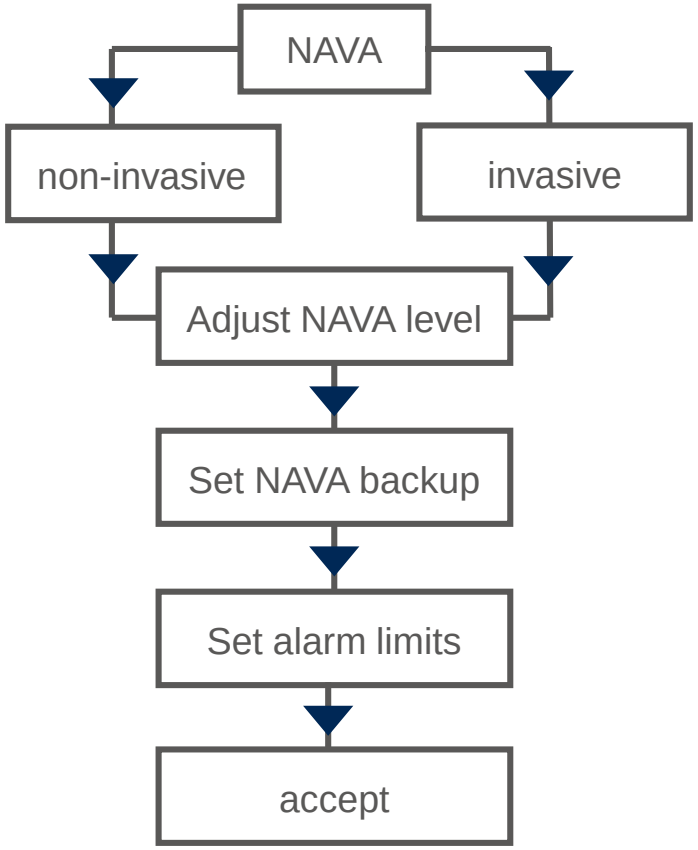
Assist pressure

Assist pressure is the difference between Edipeak and Edimin multiplied with NAVA level. In the NAVA preview window, the estimated initial Ppeak in NAVA is estimated as Pest.



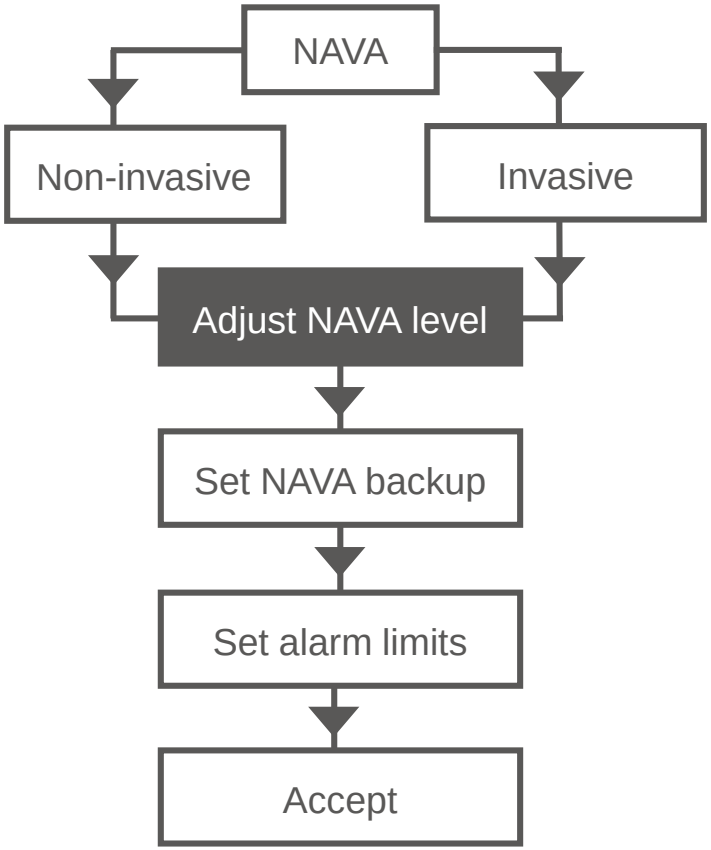
Select and set NAVA mode

Workflow



Select and set NAVA mode

Adjust NAVA level



Set initial NAVA level

Option 1

Set the NAVA level initially to 1.0 invasively and 0.5 non-invasively. Wait a few breaths for stabilization.

Targets for the Edi signals:

- NAVA 10 ± 5µV
- NIV NAVA 15 ± 5µV

Typical NAVA level range is between

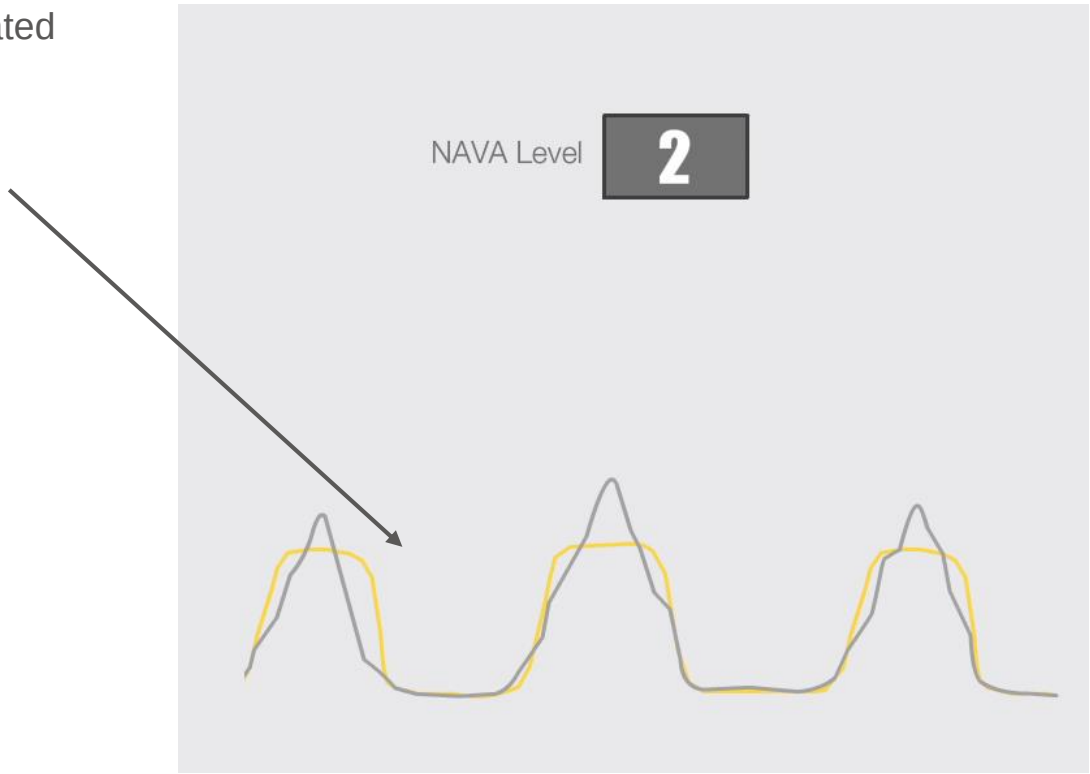
0.5 - 3.0.

Usually a lower NAVA level is used in NIV NAVA.

Set initial NAVA level

Option 2

Set the NAVA level so that the estimated pressure curve is below the actual pressure curve (yellow)



Select and set NAVA mode

What happens when the NAVA level is increased?

Conventional ventilation

In conventional Pressure Support, the tidal volume will increase when assist level is increased.

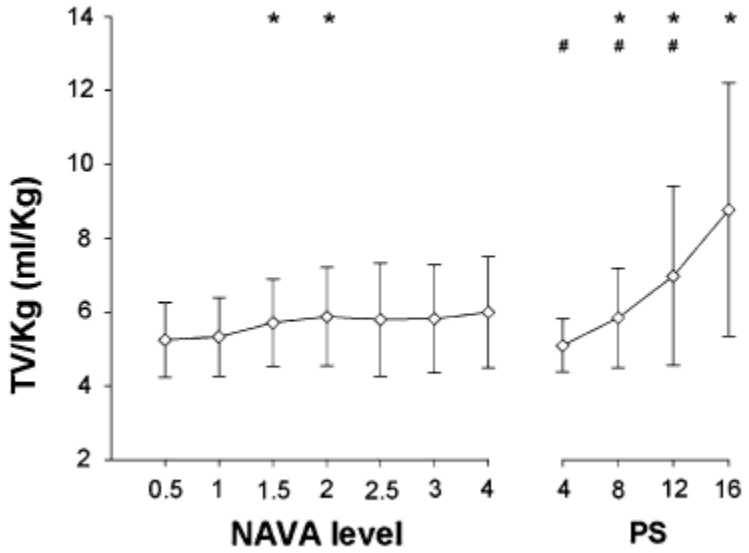
NAVA ventilation

In NAVA, the patient chooses the tidal volume. When you increase the NAVA level, the tidal volume may increase initially, but it will not continue to increase. Instead the Edi peak level will start to decrease.

When the NAVA level increase, the Edi peak decrease.

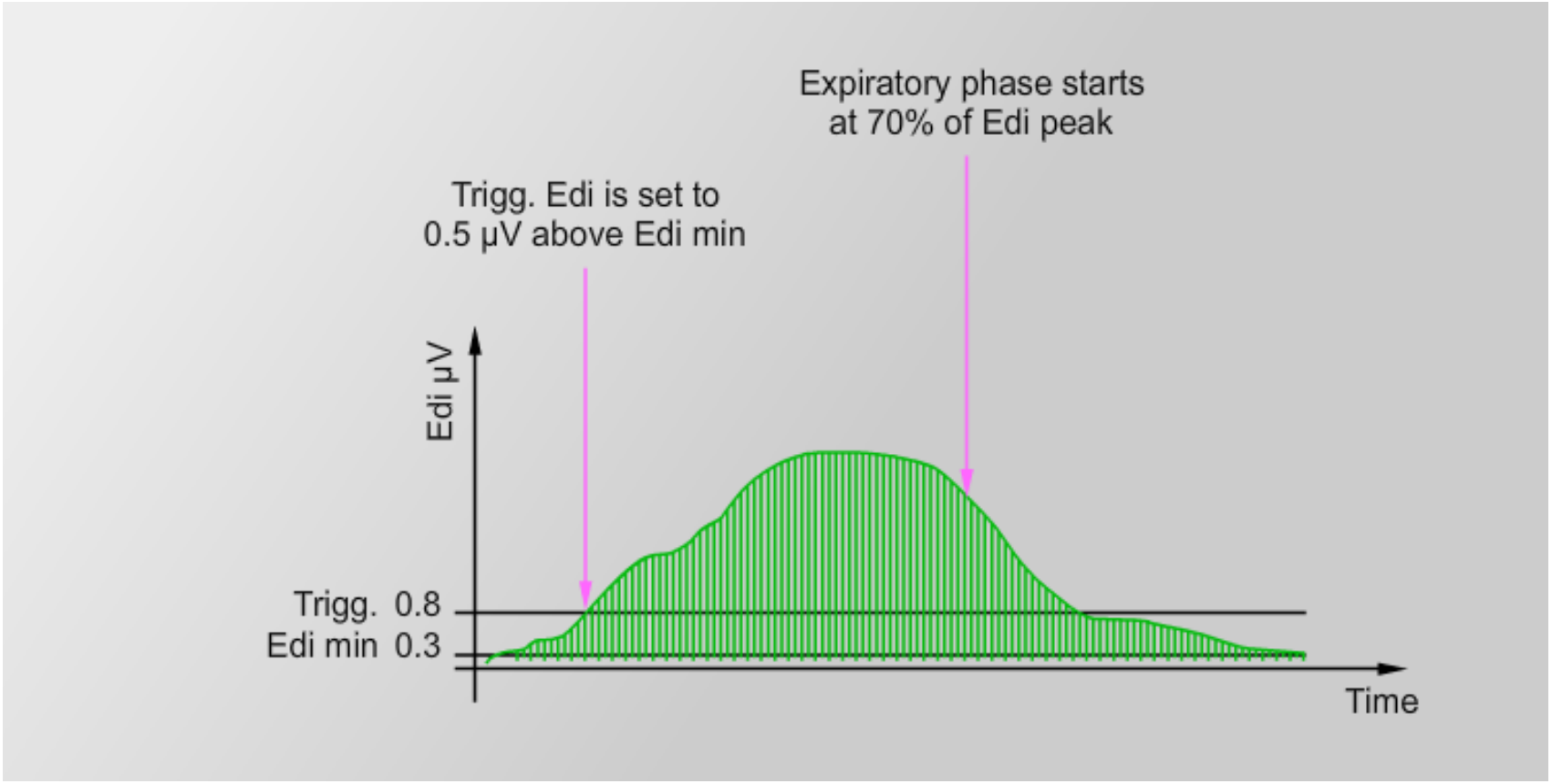
NAVA

Marginal effects on VT while increasing NAVA level



Select and set NAVA mode

The Edi trigger

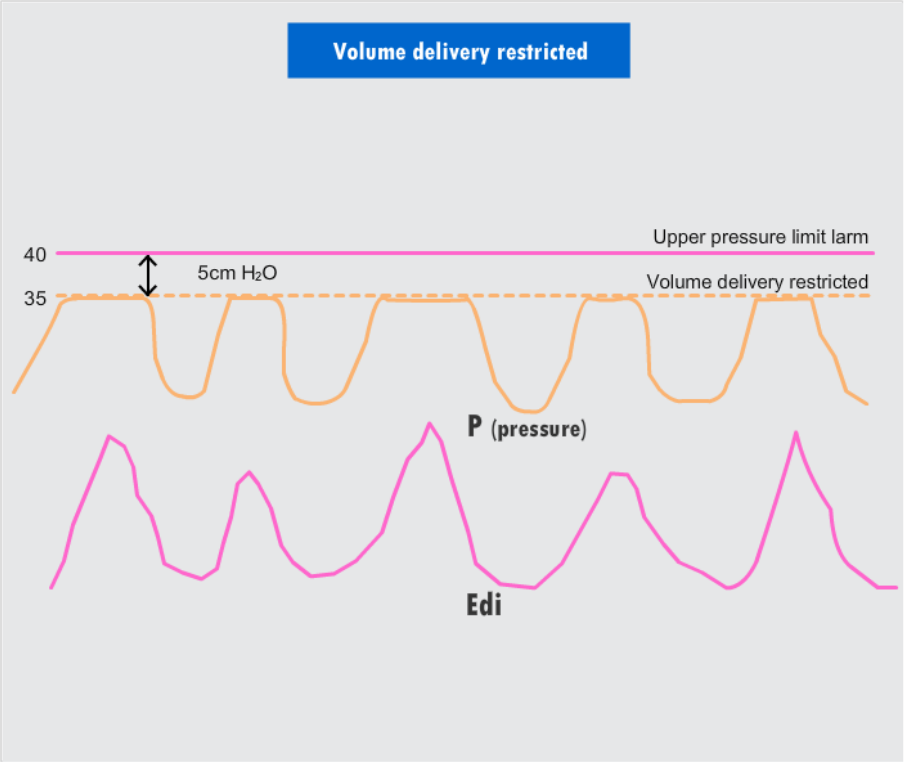


Select and set NAVA mode

Set alarm limits

Message: Volume delivery restricted

The pressure is limited to 5cm H_20 below the set upper pressure limit, which restricts the volume delivery



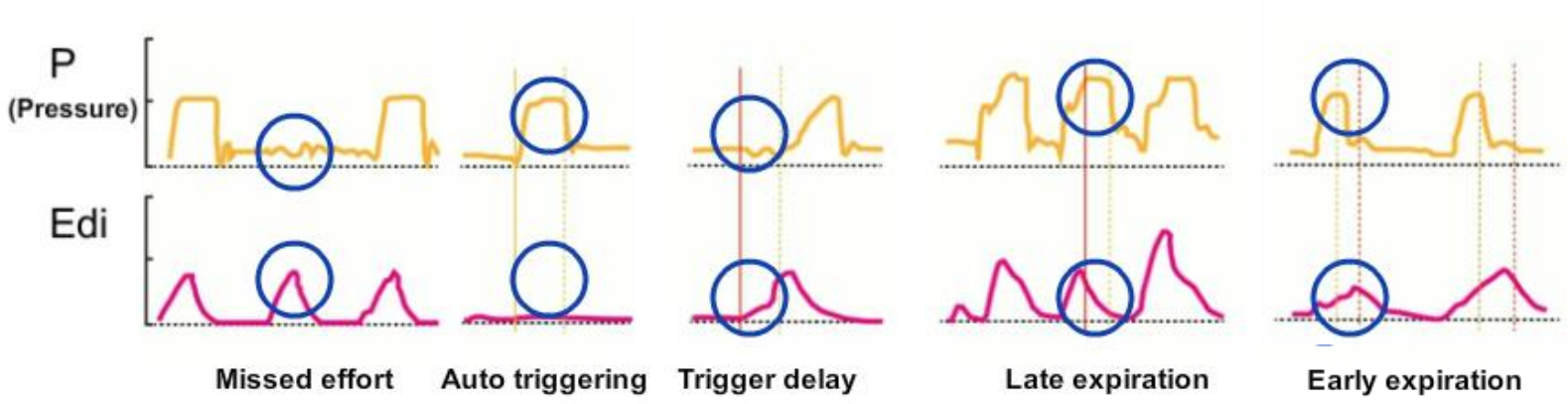
Select and set NAVA mode

Ventilate with NAVA

The pressure curve in both NAVA and NIV NAVA follows the Edi signal pattern. The support is proportional during the inspiration.

Edi monitoring

Evaluate asynchrony



Disclaimers

CAUTION: Federal (USA) law restricts this device to sale by or on the order of a physician.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