NON INVASIVE VENTILATION IN ICU

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INTRODUCTION:

Critical care is an upcoming speciality where anaesthesiologist can do wonders with their knowledge, skill and swift decision making. Advancement in critical care is at a fast pace and it becomes more vital for us to be aware of recent concepts and trends in it.

One such new thing in ICU is the application of non-invasive ventilation for selected patients

As anaesthesiologist we are more aware of mechanical ventilation and its consequences. But at the same time this new mode of ventilation is gaining popularity mainly because of its simplicity and non-invasiveness.

So what is NIV? What are the indications for it? Can it replace the routine mechanical ventilation? Which patient subgroup gets its maximum benefit? How to use it wisely in a step by step manner? Let us try to find the answers for the above questions

**DEFINITION:**

Application of artificial ventilation without any conduit access to the airways i.e. without an endotracheal tube or tracheostomy.

Non-invasive ventilation initiation requires equipments like 1) a tight fitting face mask/nasal mask 2) circuit 3) oxygen tubings, humidifier and most importantly a ventilator

Ventilators presently available in the market are exclusive NIV ventilators which are light weight, portable and standard ICU ventilators which has the facility to deliver NIV.

**DEVICES NEEDED TO DELIVER NIV**:

Patient Interface: nasal mask, full face mask and facial helmets are the various interfaces used to deliver NIV. To choose the correct size mask appropriate for the patient there are various size gauges provided by the manufacturer.

Straps and foam bridge for forehead application also comes along with the mask assembly which aids in proper fitting of the mask. Ideally one finger should be able to insinuate between the mask and face.

Other accessories needed are ventilator circuit, oxygen tubing and humidifier

Ventilators used to deliver NIV are of two types:

**NONINVASIVE VENTILATORS**: these are electrically powered; microprocessor controlled and has a single circuit for delivery of gas at a set flow rate. Flow and pressure are measured in this device and they are capable to adjust for leaks present. Alarms for circuit disconnect loss of power and battery failure is present in these ventilators. The main disadvantage of these ventilators is the difficulty in obtaining FiO2 > 0.50 and rebreathing possibility is there as it is a single circuit design with a small expiratory port.

**CRITICAL CARE VENTILATORS**: These are pneumatically powered, microprocessor controlled, have a dual limb circuit.FiO2 delivery is accurate and high flow rate can be achieved easily. The main disadvantage is the excessive sensitivity to leaks in the mask and subsequent alarming.

**MODES OF NIV:**

There are four modes possible in NIV machine. They are

Spontaneous mode: ventilator follows patient’s spontaneous breathing and delivers set pressure during inspiration and expiration. It is ideal for patients with good spontaneous respiratory drive. The ventilator doesn’t have backup breath rate.

Spontaneous mode/ timed mode: here the backup respiratory rate is set apart from the pressures setting. So the patient’s rate is monitored and if it falls below the set rate, ventilator will start delivering. It is ideal for patients going for apnoea during sleep.

Timed mode: here the respiratory rate and inspiratory time are set. So a fixed rate at fixed inspiratory time will be delivered to patient regardless of his effort.

CPAP mode: a fixed set pressure is delivered throughout the respiratory cycle

**SETTINGS OF A NIV MACHINE**:

The control panel of a NIV ventilator has following parameters:

MODE: spontaneous, timed and spontaneous/timed

IPAP: to set inspiratory positive pressure

EPAP: to set expiratory positive pressure

BACKUP BREATH RATE

RAMP TIME

RISE TIME

I: E RATIO

Ventilators usually display the following parameters:

Tidal volume

Mask leak

Respiratory rate

Minute ventilation

Apnoea

**INDICATIONS FOR NON INVASIVE VENTILATION:**

STRONG EVIDENCE: COPD exacerbation

Acute cardiogenic pulmonary oedema

Immunocompromised patients

Facilitate extubation in COPD

INTERMEDIATE EVIDENCE: postoperative respiratory failure

Hypoxemic respiratory failure

Palliation in DNR/DNI patients

Postextubation respiratory failure

WEAK EVIDENCE: ALI/ARDS

Pneumonia

Bronchial asthma

Contraindications to NIV:

CARDIOPULMONARY ARREST, SHOCK

UNCONTROLLED MYOCARDIAL ISCHEMIA, ARRHYTHMIAS

COMA

COPIOUS SECRETIONS

RECENT ESOPHAGEAL SURGERY

CRANIOFACIAL ABNORMALITY

**INITIATION OF NIV IN ICU SETUP:**

In our clinical practice, we usually come across patients with acute breathlessness of varied aetiology. The medical management should be started immediately as per the clinical condition requirement. Whether to intubate or go for a NIV trial needs lot of clinical acumen and swift decision making skill. We cannot think of NIV in a cardiac arrest patient and we have the liberty to choose NIV for acute COPD exacerbation. As per the above mentioned indications, NIV can be initiated and steps given below will be a guide:

Ensure appropriate indication

Explain to the patient and assure him

Do a baseline ABG

Place the patient at an angle of > 30 degrees

Optimise conventional therapy for the medical condition as NIV alone cannot cure the patient.

Discuss with the family about the option of mechanical ventilation if NIV fails

Select your ventilator – BIPAP or Critical care ventilator

Select correct sized interface

Set IPAP and EPAP. Start with 8-10 & 4-5 cm H2O respectively and then gradually titrate as per the patient need.

Set backup breath rate 12-14 is ideal.

Give supplemental oxygen to maintain oxygen saturation of > 90%

Apply the mask first without ventilator hose. Fit it with straps and then apply ventilator hose to the mask.

Check for air leaks and adjust the strap accordingly.

Do not forget to obtain ABG 1 hr after initiation of NIV

MONITORING DURING NIV:

Ideal place to initiate NIV is ICU, but it can also be done in a ward setup or home based treatment. The most important thing is to have a well trained staff by the bedside who should be able to identify the detoriation earlier. Physiological monitoring includes SpO2, exhaled Tidal volume and ABG.The patient should be observed for respiratory rate, chest wall movement, coordination of respiratory effort with NIV, accessory muscle use and mental status. Subjectively the patient will feel comfort and less dyspnoeic.

Decrease in PCO2 and increase in blood pH in the first hour ABG are good prognostic indicators.

**COPD and NIV:**

Acute exacerbation of COPD was treated earlier with intubation and mechanical ventilation. Weaning and extubation of a COPD patient is one of the most difficult clinical scenario in critical care setup. Use of NIV had revolutionised the practice and evidence is accumulating in favour of NIV .It decreases the mortality, length of stay in ICU and prevent pneumonia. NIV should be initiated early in COPD as success rate falls at late stage of initiation.

**ACUTE CARDIOGENIC PULMONARY EDEMA AND NIV:**

In addition to standard medical treatment, NIV preferably CPAP has a level I indication in these patients. it improves PF ratio, decreases respiratory rate and dyspnoea and reduce the need for intubation.

**HYPOXEMIC RESPIRATORY FAILURE AND NIV:**

As this clinical condition has varied aetiology, use of NIV had shown conflicting results

Few studies had shown that NIV reduces intubation rate, improves gas exchange.

In a small RCT, it was shown that NIV group of patients had a higher mortality rate. It is attributed to the delay in intubation that occurred.

Few points to be kept in mind when initiating NIV for hypoxemic respiratory failure patients: Always use ICU ventilators for precisely titrated FiO2

Pressure preset mode with PEEP is preferable.

Use higher flow rate

Go for intubation if there is no improvement in mental status, gas exchange happens within 30-60 minutes of initiating NIV.

**WEANING FROM MECHANICAL VENTILATION**:

NIV act as a bridge between invasive ventilation and spontaneous breathing. keeping the patient in NIV after extubation reduces the chance of reintubation and risk of nosocomial pneumonia. Various reports are found in literature supporting NIV in intubated COPD patients, aged patients, and cardiac failure patients. THERE IS NO RECOMMENDATION so FAR to support the routine use of NIV after extubation in all patients.

**ACUTE LUNG INJURY AND NIV:**

Evidence does not support the routine use of NIV in patients with ALI/ARDS.In a trial by ANTONELLI, ARDS was identified as a risk factor for NIV failure. A recent cohort study showed that some patients especially less severely ill, without shock and metabolic acidosis may benefit from NIV .Close monitoring is essential and if PO2/FiO2 ratio does not improve after 1 hour, intubation and mechanical ventilation should be initiated.

**TROUBLE SHOOTING IN NIV**:

Patients should be closely monitored once they were put on NIV and a backup plan of intubation and ventilation should be done rapidly to avoid mishaps and mortality.

A patient on NIV should be monitored for PaO2, PaCO2, mental status changes and asynchrony

Remedial measures for a low PaO2 after NIV initiation should be increasing O2 flow, increasing EPAP, increasing inspiratory time

If the ABG shows high PaCO2 after initiation of NIV, check for leaks and rule out rebreathing.increasing IPAPand backup RR will also help in bringing down the PaCO2

Asynchrony can happen if the patient is too anxious, high ventilator demand, low flow rate, inappropriate settings and leaks.

**FAILURE OF NIV**:

It can be classified as two types: **EARLY**- apparent failure to initiate therapy or within 48 hrs of initiation. The causes are mostly technical and compliance problems

**LATE**: can happen after 48 hrs of initiation

Most likely causes are: low pH initially (<7.22)

High APACHE II

Pneumonia

Excessive secretions

Underweight patients and

Persistent leak from interface

**CONCLUSION:**

The role of NIV is gaining importance as the evidence supporting its use in certain forms of acute respiratory failure accumulates. It has become an important part of critical care armamentarium. Patient selection is more important for its success and it should never be considered as an opponent to intubation and ventilation. A careful assessment within 1-2 hrs of initiation is important in determining the likelihood of success with NIV.

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THANK YOU .

1. [↑](#endnote-ref-2)