Sleep-Disordered Breathing

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A 50 years old morbidly obese female patient, a known case of diabetes, hypertension, hypothyroidism and bronchial asthma was admitted to the ICU with a history of sudden worsening of breathlessness, cough with expectoration, wheezing and palpitation. On examination she was visibly breathless, mildly drowsy with tachycardia and tachypnea. Her oxygen saturation by pulse oximetry was 80% and blood pressure was 180/100 mmHg in the right arm in supine position. Her arterial blood gases were suggestive of acute on chronic respiratory academia with marked hypoxemia. On examination of respiratory system there was bilateral wheeze and basal end inspiratory crackles. She was diagnosed as a case of acute asthma with obesity hypoventilation syndrome with hypercapnic respiratory failure. She was treated in the ICU with steroids, bronchodilators, oxygen and non-invasive ventilation.

Sleep-disordered breathing (SDB) has been increasingly recognized as an independent cause or an important factor contributing to the development of acute respiratory failure in the ICU. The two most commonly encountered conditions in ICUs are overlap of OSA and COPD, and obesity hypoventilation syndrome. Appropriate and timely treatment can change the outcomes in these patients.

Step 1: Initiate Resuscitation

- Initiate resuscitation as described in Chap. 23, Vol. 2.

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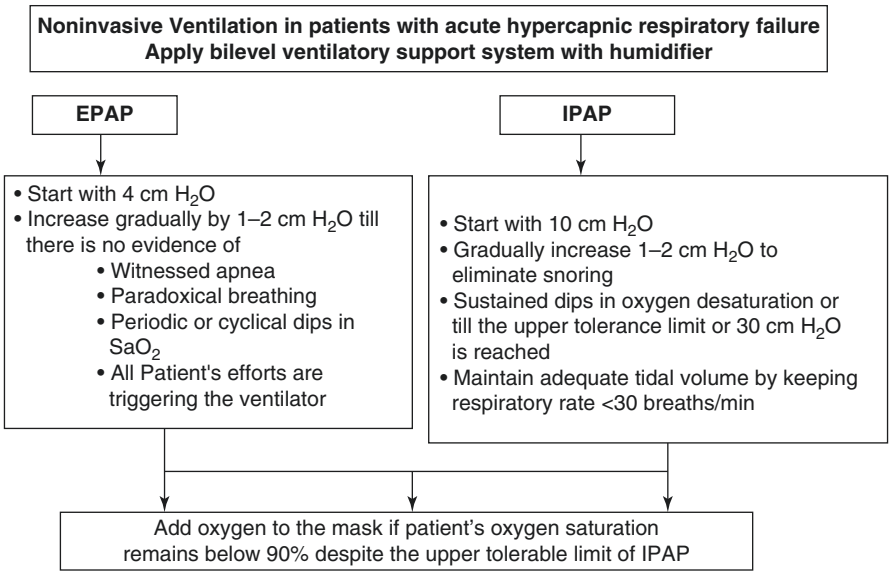

Fig. 15.1 Suggested guidelines for titration of NIV

- It is important to suspect the presence of SDB and obesity hypoventilation syndrome (OHS) in every obese patient of hypercapnic respiratory failure so that an early and effective treatment can be initiated.
- Apply noninvasive ventilation (NIV) immediately as these patients with SDB and hypercarbic respiratory failure respond very well to this modality.
- It also helps in controlling the precipitating illnesses such as congestive heart failure and respiratory muscle fatigue as seen in acute exacerbation of COPD.

The goals of treatment are to reverse sleep-induced hypoventilation and upper airway obstruction and to optimize oxygenation. The algorithm for titration of NIV is shown in Fig. 15.1.

Step 2: Take a Detailed History and Do Physical Examination

Identify symptoms and signs of obstructive sleep disordered breathing and obesity hypoventilation syndrome.

In all obese patients with hypercapnic respiratory failure, SDB should be considered an important cause. The common symptoms are as follows:

- Fatigue
- Loud interrupted snoring
- Excessive daytime sleepiness
- Witnessed apneas

- Nocturnal awakening, snorting, or gasping
- Unrefreshing sleep
- Mood disorders
- Morning headaches
- Large neck circumference
- Poorly controlled hypertension
- Craniofacial abnormalities (micrognathia, retrognathia, macroglossia)
- Breathlessness on minimal exertion

Step 3: Admit to the ICU

The patient should be admitted to the ICU if any of the following criteria are met:

- Acute acidemia—pH less than 7.30
- Decreased level of consciousness or coma
- Hemodynamic instability
- Refractory hypoxemia
- Intolerance to continuous positive airway pressure (CPAP) therapy

Step 4: Understand Respiratory Failure in SDB

- SDB constitutes a spectrum of disorders of various severities with intermittent snoring as the mildest form at one end and OHS as the most severe form at the other end of the spectrum. Heavy snoring and upper airway resistance syndrome and mild, moderate, and severe sleep apnea lie in between these two extremes.
- The patients commonly encountered in the ICUs generally suffer from severe obstructive sleep apnea syndrome (OSAS) and/or OHS or those with overlap syndrome, that is, when OSAS occurs simultaneously with chronic obstructive pulmonary disease (COPD).

  Respiratory failure in sleep occurs because of the following reasons:

- Increased airflow resistance due to partial or complete obstruction of the upper airway.
- Decreased ventilatory response to hypoxic and hypercapnic stimuli.
- Marked hypotonia of accessory muscles of respiration, particularly during rapid eye movement (REM) sleep leading to severe hypoventilation.
- Altered lung mechanics due to obesity result in decreased functional residual capacity (FRC), expiratory reserve volume (ERV), vital capacity (VC), and forced expiratory volume in 1 s (FEV1).
- The consequences of untreated SDB include hypertension, stroke, cardiac failure, and excessive daytime sleepiness.

Respiratory failure is usually precipitated by complicating respiratory illnesses such as infections, acute exacerbation of asthma and COPD, and congestive cardiac failure.

Step 5: Perform Relevant Laboratory Investigations

- Complete blood counts
- Blood glucose (fasting and postprandial)
- HbA_1C
- Lipid profile
- Thyroid function test
- Serum electrolytes
- Arterial blood gases
- ECG
- Chest X-ray
- Echocardiography
- Spirometry

Step 6: Monitor Closely During NIV

The following parameters should be monitored during treatment:

- The level of consciousness
- Vital signs
- Respiratory rate
- Use of accessory muscles
- SaO_2, end-tidal CO_2
- Triggering
- Patient–ventilator synchrony
- Esophageal pressure monitoring (selected cases)
- Arterial blood gas frequently

Precautions

- In patients with overlap syndrome, expiratory positive airway pressure (EPAP) higher than auto-positive end-expiratory pressure (auto-PEEP) may worsen the hyperinflation, leading to increase in respiratory rate and work of breathing.
- There may be worsening of blood gases in the first few days due to intense hypoventilation caused by rebound increase in delta and REM sleep.

Step 7: Intubate If Indicated

Indication of Intubation and Mechanical Ventilation

- NIV failure.
  - Worsening mental status
  - Deterioration of pH and $PaCO_2$ after 1–3 h of therapy
  - Refractory hypoxemia
  - Intolerance to NIV
- Hemodynamic instability.
- Inability to clear secretions.
- Intubation of the patient with severe OSAS or OHS is associated with significant difficulties and complications due to limited mouth opening and neck mobility.
- The pharynx is anatomically small with large tongue. The ability to withstand apnea or hypopnea is poor due to low oxygen reserves associated with decreased FRC.
- The intubation should be done by an experienced intensivist.

Indications of Tracheostomy

- It was the main treatment before the development of NIV. Now, it is used occasionally in patients who cannot tolerate NIV or have poor compliance to NIV or who cannot be successfully extubated after a period of mechanical ventilation.

Step 8: Manage Comorbid Medical Conditions

- Most patients of SDB and OHS have concomitant respiratory, cardiac, and metabolic comorbidities such as COPD, asthma, congestive heart failure, and diabetes.
- In addition to NIV and oxygen, the appropriate treatment of these conditions should also be instituted.

Step 9: Plan a Sleep Study (Polysomnography) Before Discharge

- Although some patients may already have the diagnosis, majority of the patients presenting to the ICU with acute respiratory failure had no prior diagnosis.
- OSA are at risk of Motor Vehicle accident (MVA) while driving and this history should be ellicited in all MVA patients at risk for OSA.
- If the diagnosis of OSAS or OHS is suspected, a bedside sleep study may be performed for both diagnostic and titration purposes. However, if the bedside sleep laboratory is not available, the patient can be treated empirically with NIV with the help of a pulse oximeter, as shown in Fig. 15.1.

Diagnostic Criteria for SDB

- The third edition of the International Classification of Sleep Disorders defines sleep disordered breathing as a significant disorder when a patient has a respiratory distress index (RDI) i.e., (apneas + hypopneas + respiratory effort-related arousals) of more than or equal to five per hour of sleep along with clinical presentation such as excessive daytime sleepiness, unrefreshing sleep, fatigue, insomnia, mood disorders, or other neurocognitive disturbances.
- The severity of SDB is assessed by the number of abnormal breathing events per hour of sleep, the degree of sleepiness, and the degree of oxygen desaturation during sleep.

Mild	RDI	5–15/h of total sleep time
Moderate	RDI	16–30/h of total sleep time
Severe	RDI	>30/h of total sleep time

RDI respiratory disturbance index

Diagnostic Criteria for OHS

- BMI more than 30 kg/m^2
- Daytime alveolar hypoventilation (awake arterial $PaCO_2 > 45$ mmHg)
- Severe OSA (AHI > 30/h) or severe oxygen desaturation
- Absence of other causes of hypoventilation

Suggested Readings

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