A 40-year-old male patient is admitted to ICU with complaints of purulent cough, fever, restlessness and difficulty in breathing. He has past history of asthma for 10 years, managed on inhaled bronchodilators. Since past one month he was started with oral prednisolone 10 mg OD due to exacerbation of symptoms. On physical examination his respiratory rate is 36 breaths/min, O2 saturation 71%, HR 130/min and BP 140/86 mmHg. He is initially provided BIPAP support with high flow O2 but deteriorates and becomes unconscious. Patient is intubated and kept on ventilator support in CMV mode with infusion of vecuronium and midazolam. On 2nd day of admission his SpO2 and PaO2 readings show declining trends and the attending anesthesiologist changes the ventilator mode to airway pressure release ventilation (APRV) with increase in FiO2 to 90%. The patient shows improvement by next day and is weaned off from ventilator over next 2 days.

Q.1: Characteristics of airway pressure release ventilation (APRV) include all except:
   a) Spontaneous ventilation is allowed at high CPAP phase only
   b) Duration of low CPAP is limited to 1.5 sec or less
   c) Decreases intrapulmonary shunt, and V/Q mismatch
   d) Suited for difficult to wean patients

Q.2: Cardiovascular effects during inspiratory phase of mechanical ventilation include all except:
   a) Decreased venous return to heart
   b) Impaired right ventricular emptying
   c) Increased afterload for left ventricle
   d) Increased preload to left atria

Q.3: Proportional assisted ventilation (PAV) is inappropriate to use in all except:
   a) Heavy sedation
   b) Neuromuscular weakness
   c) Broncho-cutaneous fistula
   d) No respiratory efforts despite abnormally low pH

Q.4: ‘Neurally Adjusted Ventilatory Assist’ (NAVA) works on the principle of all except:
   a) Latency from phrenic stimulation to diaphragmatic action potential is approx 6-8 millisec
   b) Assist is triggered by diaphragmatic electrical activity (Edi) or flow
   c) Time from central respiratory output to initiation of inspiratory flow is approx 26-28 millisec
   d) Interference-pattern EMG signals detected electrodes placed on gastric catheter

Q.5: NAVA is contraindicated in all scenarios except:
   a) Edi is absent
   b) Nasogastric and/or orogastric catheters are contraindicated
   c) Ventilatory parameters are unacceptable
   d) Patient who fails spontaneous breathing trial

Q.6: Advantages of Pressure Regulated Volume Control Ventilation (PRVC) include all except:
   a) Inspiratory pressure automatically adjusted to changes in compliance
   b) Suitable for patient with asthma or COPD
   c) Decelerating inspiratory flow pattern
   d) Automatic weaning as patient effort improves

Q.7: Adaptive Support Ventilation (ASV) has been designed to target all except:
   a) Episodes of central apnea
   b) Respiratory muscle myopathy
   c) Patient ventilator asynchrony
   d) Difficult weaning

Q.8: High Frequency Oscillation Ventilation (HFOV) is indicated in all except:
a) COPD  
b) ARDS  
c) ECMO candidates  
d) Air leak syndrome

Q. 9: HFOV minimizes ventilator associated lung injury by all except:

a) Delivering extremely small tidal volumes  
b) Small pressure swings  
c) Decelerating inspiratory flow  
d) Deep sedation

Q. 10: Automatic Tube Compensation (ATC) involves all except

a) Can be applied to all ventilation modes  
b) Pressure delivered is active during inspiration  
c) Desirable in high inspiratory flow requirements  
d) Used to train respiratory muscles

ANSWERS

Ans 1 (d) APRV does not provide breath to breath assistance, an ideal requirement for difficult to wean patients. It is only indicated in ARDS or atelectasis scenario to improve the alveolar recruitment and intrapulmonary shunts.

Ans 2 (c) Cardiac afterload is the peak tension developing across the ventricular wall during systole. It varies inversely with change in pleural pressure. Inspiratory phase of mechanical ventilation generates a positive pleural pressure which leads to decrease in afterload to heart.

Ans 3 (a) Safe use of PAV requires that the patient's respiratory muscle output be responsive to changes in PaCO₂, PaO₂, and pH. Absolute contraindications are patients with central apnea or very weak efforts and no respiratory distress despite an abnormally low pH. Patients who require heavy sedation should not be placed on PAV initially.

Ans 4 (b) In NAVA, the assist is triggered by a change in Edi or flow on a "first-come, first served" basis and not at any absolute levels; the latter would not function when tonic Edi is present. If pneumatic triggering occurs, a pressure of 2 cm H₂O is delivered until the Edi appears.

Ans 5 (d) NAVA is especially useful in patients at risk for prolonged mechanical ventilation and who fail spontaneous breathing trials, as long as spontaneous efforts are present.

Ans 6 (b) PRVC is less desirable in asthma/COPD as PRVC primarily achieves the volume limit while keeping inspiratory pressure to lowest possible limit by altering the inspiratory flow and time. Thus any increase in inspiratory time is detrimental for COPD patients.

Ans 7 (b) Disadvantages of ASV includes possible respiratory atrophy, varying mean airway pressure and a sudden increase in respiratory rate and patient demand may result in a decreased ventilator support.

Ans 8: (a) HFOV is not desirable in COPD, asthma and interstitial lung diseases.

Ans 9 (c) HFOV delivers a constant flow (bias flow) and its piston pump oscillates at frequencies ranging from 3 Hz to 15 Hz (180 breaths/min to 900 breaths/min).

Ans 10 (b) With ATC, the pressure delivered by the ventilator to compensate for the airflow resistance is active both during inspiration and expiration.

REFERENCES