CHRONIC ALVEOLAR HYPOVENTILATION

BASICS OF VENTILATION PHYSIOLOGY
- Tidal volume (VT) = Vdead space (Vd) + V alveolar (VA)
- Minute ventilation (MV) = TV x RR
- VA = Vco2/Paco2 x K (constant)

ETIOLOGIES OF ALVEOLAR HYPOVENTILATION
- Chemo sensitivities/sensors
  - Appropriate response to primary metabolic alkalosis (1mEQ HCO3 corresponds to 0.6 mmHg rise of PaCO2)
  - Impaired peripheral chemo receptor (carotid bodies) response to hypoxia-s/p CEA
  - Impaired central chemo receptor (midbrain and medulla) response to acidosis
- Brain stem dysfunction (medulla central pattern generator cells)
  - Stroke-thrombosis, embolic, bleed
  - Infiltration-neoplasm, sarcoidosis
  - Demyelinating disorders-MS
  - Drug/toxins-narcotics, BDZ, ETOH
  - Infection-encephalitis, bulbar poliomyelitis, basilar meningitis
  - Primary alveolar hypoventilation
- Spinal cord, peripheral nerves and respiratory muscles dysfunction
  - Motor neuron disease-ALS, polio
  - Peripheral neuropathy-phrenic nerve compression, resection, GBS,
  - Neuromuscular junction-MG, ELS,
  - Myopathies-drugs, dystrophies, hypothyroidism, DM/PM
- chest wall dysfunction: stiff chest wall imposes large elastic load on the lung, increase work of breathing, increased dead space ventilation (tachypneic with small TV breaths)
  - Obesity hypoventilation (Pickwinian syndrome)
  - Kyphoscoliosis
  - Fibrothorax
  - Post-thoracoplasty
  - Ankylosing spondylitis
- Lung and airways dysfunction
  - COPD-increased dead space ventilation
  - Upper airway obstruction
  - Cystic fibrosis
  - Obstructive sleep apnea

REASONABLE DIAGNOSTIC APPROACH TO A PATIENT: check a TSH
- ABG: elevated A-a gradient is seen in disorders of chest wall, lung or airways; normal A-a gradient with central or neurological disorders
- PFT’s: restrictive pattern is seen with chest wall disorders, obstructive with airway disease, PI/PE max are decreased with neuromuscular disorders
Sleep studies: central apneas seen with central disorders, obstructive apneas with OSA, note all disorders will worsen with sleep
If above studies are normal, tests of respiratory control can be performed. Pt is stimulated by hypoxia and hypercapnea and ventilatory responses are recorded.
Consider: diaphragmatic EMG to evaluate phrenic nerve, MRI head for brainstem mass

COMPLICATIONS OF CHRONIC ALVEOLAR HYPOVENTILATION
- Decreased alveolar ventilation results hypercapnea, and hypoxemia.
- Sleep accentuates these abnormalities because of decreased respiratory drive
- Physiologic consequences include increased erythropoiesis, metabolic alkalosis, pulmonary vasoconstriction, cerebral vasodilatation, impaired sleep
- Clinically, patients present with polycythemia, pulmonary hypertension, cor pulmonale, morning headache, fatigue, daytime somnolence and poor sleep

References:
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