Hyperventilation Syndrome Differential and Management

Cline: ch. 25 ; ch. 37
Brady pp 583; 694
(+/or other standard paramedic text)

Objectives

Upon completion of this lecture you should be able to discuss :

- The common clinical occurrence of hyperventilation
- The problematic tendency to assume that the hyperventilating patient is not acutely ill
- The differential diagnosis of life-threatening causes of combination of tachypnea and anxiety
- The importance knowing that 1st responders can harm patients with "paper bag treatment"

Objectives , continued

- Pathophysiology of hyperventilation
- Presenting history and physical
- Consequences of pCO2 and Ca++ abnormalities in HVS
- Approach to the HVS patient
  - Use of medications in HVS
  - Treatment of HVS by resetting the patient's minute ventilation and residual lung volume

Life-threatening Presentations with Tachypnea and Anxiety

- Mimics of HVS (to name just a few):
  - MI
  - Spontaneous pneumothorax
  - Pulmonary embolism
  - CHF
  - Hyperthyroidism
  - Metabolic acidosis

Hyperventilation Syndrome (HVS)

- Common
- Easily recognized by most emergency clinicians
- Precise pathophysiology contributing to the symptomatology not always apparent
- Minute ventilation exceeds metabolic demands

Epidemiology of Hyperventilation

- Hyperventilation Syndrome (HVS) and panic disorder have considerable overlap
- 50% of panic patients have HVS
- 25% of HVS patients have panic
- Female-to-male ratio over 6 : 1
- CP with HVS [within 4 yrs]
  - 67% subsequent ED visits for chest pain
  - 40% readmitted to rule out MI

Epidemiology of Hyperventilation

- Frequency
  - 10% of patients in adult internal medicine
- Chronic HVS :
  - Can be subtle and difficult to diagnose, presenting with no obviously rapid breathing
  - Many admitted ; have elaborate evaluation [angiography]
    - considerable expense excluding serious pathology
- Acute HVS :
  - Actually less common, but more easily and more often diagnosed

Pathophysiology of Hyperventilation

- Mitral valve prolapse (MVP)
- Lactate
  - Infusion of lactate produces symptoms
  - High lactate levels:
    - in panic disorder: lactate is higher and remains abnormal longer
    - 50% high lactate will develop acute HVS
  - Abnormal metabolism of lactate
  - Whether this abnormality is causal in HVS is undocumented

Pathophysiology of Hyperventilation

- Breathe with upper thorax, instead of diaphragm
- Results in chronically overinflated lungs
- Further deep breathing is perceived as dyspnea
- Dyspnea creates still more anxiety - as does
  - Muscle tetany
  - Muscle pain

History - Cardiopulmonary

- Chest pain
  - sudden onset
  - may resemble typical angina
  - hours ; unrelieved by nitroglycerine
  - [note: vasospasm induced by hypocarbia may be associated with myocardial injury]
- Respiratory
  - dyspnea
  - wheezing
  - sense of suffocation

HVS History - Neuro

- Neuro sx.
  - Low pCO_2 and CNS sx
    - hypocapnia causes reduced cerebral blood flow
    - for every 5 mm Hg drop in pCO_2, CBF decreases by 10%
  - "Stroke" [caropedal spasm]
  - Confusion; dizziness; agitation
  - Paresthesias
    - upper extremities; bilateral
  - Syncope or seizure

History - SAMPLE / ROS

- SAMPLE
  - meds: estrogen; BCP
- Musculoskeletal
  - cramps (tetanic)
  - Leg pain (DVT)
- Precipitating event often
- Risk factors
  - Hx of CV disease
  - BP, FH, DM,…

HVS - Physical Findings

- GEN:
  - Anxious, tremor, pallor
  - Mydriasis [epi.]
- VS:
  - tachycardia , tachypnea
  - +/- abnormal sat [nl or abn pulse oximetry does not rule in or R/O anything]
  - occasional deep sighing
  - BP : Trousseau sign [hypocalcemia]

HVS - Physical Findings

CHEST

- Wheezing +/- [bronchospasm from hypocarbia]
- Chest wall tenderness
  - Does **NOT** R/O other diseases
    - Coronary disease
    - Pul. Embolism
    - Pneumothorax
    - Pneumonia

HVS - Physical Findings

- MS [acute hypocalcemia]
  - carpopedal spasm,
  - muscle twitching,
  - positive Chvostek [cheek] sign

HVS - Lab Findings

- ABG
  - Acute
    - low pCO_2 (20)
    - alkaline pH (7.6)
    - normal bicarb (HCO_3 : 25)
  - Chronic
    - low pCO_2 (20-30)
    - normal pH (7.4)
    - low bicarb (HCO_3 : 15)
      [compensatory metabolic acidosis]

HVS - EKG Findings

ECG changes common in HVS

- prolonged QT interval [hypocalcemia]
- prolonged ST segment [hypocalcemia]
- ST depression [hypokalemia]
- ST elevation
- flat T-wave [hypokalemia]
- T-wave inversion [hypokalemia]

Prehospital Treatment of HVS

- HVS
- Dx of exclusion
- Paper bag rebreathing by first responders
  - contraindicated
  - often unsuccessful
  - may trigger more anxiety

Paramedic Treatment of HVS

Rebreathing into a paper bag

- is **NOT** recommended in the field

ED Treatment of HVS

Rebreathing into a paper bag

- And **NOT** recommended in the ED
  - until after more serious etiologies have been excluded
  - decreasing O_2 and increasing pCO_2 disastrous in:
    - pulmonary edema, metabolic acidosis
- Case reports of significant hypoxia and death
  - Deaths in misdiagnosed
    - Acute myocardial infarction
    - Pneumothorax
    - Pulmonary embolism

Respiratory Treatment of HVS

- Reassure
  - Evaluate
- Reset :
  - Minute ventilation
  - Residual lung volume

Breathing Treatment of HVS

- Instruct patient to "breathe really deep, all the way down into your abdomen"
- Abdominal breathing - using diaphragm more than the chest wall
- Slows the rate
  - Improvement in subjective dyspnea
  - Slowly corrects pCO2 and pH abnormalities
  - Slowly corrects associated symptoms

Physical Therapy of HVS

Reset Residual Volume

- Reduces hyperinflation of the lungs
  - Reduces sensation of dyspnea
  - Reduces sensation of inability to take a full tidal volume
- Technique
  - Have patient exhale maximally
  - Physically compress the upper chest

Chemical Treatment of HVS

- Acute chemical sedation
  - Selected severe cases
  - Stress reduction
  - Chronic psychotropic medications should **not** be initiated in the ED
- Medications
  - Beta-blockers
  - Selective serotonin reuptake inhibitors
  - Benzodiazepines

Medications in HVS

- Beta-blockers
  - time-tested for stress reduction in anxiety (with tachycardia)
  - reduce frequency
  - reduce severity
- Selective serotonin reuptake inhibitors
  - Paroxetine (Paxil)
  - reverse the underlying pathology (panic)

Benzodiazepines in HVS

Benzodiazepines

- Effective in reducing stress that triggered HVS
- Reset the CNS response to panic-triggers
- Low dose
  - Lorazepam 1-2 mg po, IV, or IM
  - Diazepam 2-5 mg

Summary

We have discussed :

- Pathophysiology of hyperventilation
- Clinical presentation of HVS
- Use of medications in HVS
- Treatment of HVS by resetting the minute ventilation and residual lung volume with
  - Breathing treatment
  - Physical therapy
- Teaching the first responders not to use paper bag rebreathing
- Life-threatening conditions that mimic hyperventilation syndrome