

## HYPERVENTILATION



*Ms. Sylvia Van Buran, (Ann Robinson), is suddenly grabbed from behind by a Martian, eliciting a severe case of hyperventilation, (HG Wells' "The War of the Worlds", Paramount, 1953)*

*HG Wells (1846-1946) was the first truly great science fiction writer. His most famous works included "The Time Machine", (1895) and "The Invisible Man" (1897), but probably his most famous of all was "The War of the Worlds", (1898). He was the first to introduce the classic story lines of time travel and alien invasion from another world. His stories immediately struck a cord with the public and his ideas were based on the very cutting edge of scientific thought of the time. Whereas previously science fiction had barely existed as a writing genre, Wells suddenly propelled it into the collective consciousness and it has remained in this consciousness to our own day.*

*Fear of the unknown appears to be an innate or "hard wired" feature of the human species, almost a primal instinct in all of us. The history of civilization shows a universal desire to attempt to explain the unknown and throughout the ages and across all cultures this explanation has usually been in terms of various faiths, cults or religions. The end of the Nineteenth century was a watershed period marking a decline*

*in people's faith in religion to explain the world around them as opposed to the new scientific ideas. For the first time in history the general population had wide access to these ideas which included the theory of evolution to explain man's place in the world. There was also the rapidly awakening realization of the real place of the Earth in a universe of terrifyingly immense dimensions. Further, man's place in the universe was beginning to be recognized not only in terms of physical space but also in terms of the unimaginable expanse of geological time.*

*No longer (or at least a lot less so) frightened of the unknown previously explained by religious or "metaphysical" theories, it came as a terrible shock to find that the new science far from bringing reassurance in its ability to explain the world around us, rather opened it up to whole new fields of terrifying possibilities, never before in the collective consciousness. HG Wells understood the latest scientific theories, he was a close associate of Darwin's "bulldog" Thomas Huxley. He also understood the possible implications of the new theories. If animals can evolve, and if man is but an animal, cannot he too evolve into something else? If man is not the center of the universe, then who or what else is "out there" and how would they view us? The first theme is explored in "The Time Machine", whilst the second is explored in "The War of the Worlds". Wells' brilliance lay in the fact that he could utilize the ideas of modern science to play on the primal fear of the unknown. An unknown all the more terrifying as it was based on the new scientific thinking, making it all seem... just possible?*

*When a patient presents to the Emergency Department with hyperventilation it is important to reassure them and provide explanation to allay their primal fears. It is also important however to keep an open mind and to diligently exclude any possible serious underlying cause for the hyperventilation, such as that experienced by Ms Van Burin!*

# HYPERVENTILATION

## Introduction

Hyperventilation is a common presentation in the ED. The most important task here is to distinguish benign emotional causes, or “hyperventilation syndrome”, from more serious underlying pathology.

Most simply defined, hyperventilation syndrome is a condition in which the minute ventilation exceeds the body’s metabolic demands, resulting in hemodynamic and chemical changes that produce characteristic signs and symptoms.

Serious underlying pathology however must always be considered in the differential diagnosis of a patient who presents with hyperventilation. **The most important differentials in this regard are pulmonary embolism and DKA.**

Many patients will have associated anxiety disorders such as agoraphobia.

## Pathophysiology

### Causes

1. Central CNS: exaggerated normal physiological responses invoked by:
  - Anxiety / fear / panic attack.
  - Pain.
  - Extreme emotional reactions.

More serious underlying pathology includes:

2. Hypoxia, of any cause.
3. Pulmonary embolism, (note that the patient with PE may not have hypoxia).
4. Acidosis, especially the “Kussmaul’s” respiration of ketoacidosis.
5. Drugs or poisons, including:
  - Aspirin overdose.
  - Carbon monoxide
  - Cyanide.
6. Underlying psychiatric disturbance.
7. Underlying systemic organic disease including:
  - Delirium, including drug induced or acute confusion in the elderly.

- Early septicemia.
- Early hepatic failure.

### Complications

1. Low PaCO<sub>2</sub> resulting in cerebral vasospasm:
  - If PaCO<sub>2</sub> levels get low enough (< 20 mmHg), then this may result in confusion / altered conscious state.
2. Hypocalcemia:
  - The alkalosis caused by hyperventilation results in loss of hydrogen ions from blood proteins, with subsequent binding of serum calcium.
3. Hypokalemia:
  - This may occur (as a result of the respiratory alkalosis) but tends to be less pronounced than hypocalcemia and not clinically significant.

### Clinical Assessment

#### Common associated symptoms of the hyperventilation syndrome:

These may include:

- Presyncopal symptoms.
- Syncope.
- Chest pains, muscle cramps.
- Carpopedal spasm.
- Numbness/ parasthesiae, circumorally, limb extremities (upper > lower)
- Extreme agitation / anxiety.
- Sensation of “choking” or “suffocation”.

#### Important Points on History:

1. Is there a clear cut history of an emotional precipitant?
2. Does the patient have a history of hyperventilation?
3. Does the patient have a history of anxiety related disorders?
4. Are there risk factors for pulmonary embolism?

5. Is the patient diabetic?
6. Are there any other associated symptoms, which may suggest underlying pathology, such as chest pain?

#### Important Points on Examination:

1. Assess and address any immediate ABC issues.
2. Check the pulse oximeter for hypoxia.
3. Signs of hypocalcemia including:
  - Carpopedal spasm.
  - Positive Chvostek sign.
  - Positive Trousseau sign.

#### Investigations

None may be necessary in clear cut cases of emotional hyperventilation.

If more serious pathology needs to be ruled out the following may be considered:

- **BSL**, (does the patient have diabetic ketoacidosis?)
- **CXR**, (check for pneumothorax, indirect evidence of pulmonary embolism).
- **ABGs**, especially if there is an altered conscious state.
- **ECG**, if there is significant chest pain, (rule out pericarditis/ ischemia).

Further investigation will depend on the degree of clinical suspicion for any given pathology, such as the need to rule out pulmonary embolism.

#### Management

This will of course depend on the cause of the hyperventilation if there is an underlying organic pathology.

In cases of hyperventilation syndrome:

1. The best management in the first instance is simple reassurance.
2. Rebreathing into a paper bag or Hudson mask is helpful by increasing the patient's CO<sub>2</sub> levels, thus helping to alleviate the symptoms of hypocapnia.
  - This technique should be approached with caution, however it is not always successful in anxious and uncooperative patients and may worsen

hypoxia in cases where there is more serious underlying pathology such as pulmonary embolism.

3. In cases where symptoms are severe intravenous sedation with midazolam may be required.
4. Once the patient has settled, provoking the symptoms again by having the patient voluntarily hyperventilate for 3-4 minutes has been advocated in the literature. This is said to convince the patient of the diagnosis, however it is time-consuming, requires a cooperative patient and may be ineffective, (hence not convincing the patient and so reinforcing their fears). For these reasons it is not generally recommended.
5. After a period of observation and explanation in the ED the patient may be reassured and discharged.
  - If symptoms have been recurrent and severe counseling may need to be organized.

Dr J. Hayes

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