

## Editorial

# pH of soul: how does acid-base balance affect our cognition?

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### Summary

Respiratory Alkalosis due to changes in sympathetic hyperarousal during pathological emotional states can change our cognitive abilities. This occurs through the effects of Alkalosis upon cerebral vasoconstriction and the amount of ionized calcium in the serum. The effects on our cognition and “sense of self” could be considerable.

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Dr. A. Farnam obtained his MD (1994) from Tehran University of Medical Sciences, and completed his residency (2002) in Psychiatry at Tabriz University of Medical Sciences (TUOMS). He is Associate Professor of Psychiatry at TUOMS. He is a member of the working group for Revision of Personality Disorder Section of ICD-11 at WHO. His researches focused on a translational approach fostering molecular cellular aspects of personality. He envisions the cognition as a complex flow of life!



Maintaining a stable blood pH is one of the most important homeostatic duties of body in living creatures. All cells require PH of bodily fluids to be maintained around 7.4 in order to continue their optimal functions. Renal and respiratory systems are the two main operating systems in this field. The action of renal system, which operates by controlling the excretion of H<sup>+</sup> through urine, is slow but profound indeed. In contrary, the respiratory system's performance (through controlling CO<sub>2</sub> excretion) is quicker but more superficial. Unlike renal system, respiratory system represents some kind of “mutual relationship” with psychic apparatus, especially its “emotional” compartment. Any kind of emotional arousal, as it occurs in states of fear, anger, excitement, and even love, by means of changing the respiratory pattern, can influence the pH of bodily fluids and thereby exert a thorough effect upon all the bodily organs.

In aroused states, demand for oxygen in the body considerably increases but the permeability of CO<sub>2</sub> in the lungs is almost 40 times greater than that of O<sub>2</sub>; so the resulting hyperventilation can culminate in low blood CO<sub>2</sub> (hypocapnea). CO<sub>2</sub> is not merely a waste product; it plays an important role in maintaining the acid–base balance within the internal milieu of the body. As respiratory system is controlled directly by autonomic system, psychic conditions (e.g., emotions, thoughts, imaginations, etc.) can affect it swiftly through autonomic system.

Here, we have to point to the concept of “arousal” because all psychic conditions cause changes in the level of psychic arousal and this manifests itself as changes in the functions of bodily organs.

Arousal is the physiological and psychological state at being awake or reactive to stimuli. It involves the activation of “reticular activating system” in the brain, the autonomic nervous system and the endocrine system, leading to a fight and flight response and a condition of sensory alertness, mobility and readiness to response.

Actually any state we experience inside ourselves, whether thought, imagination, memory, emotion, etc., if it would be stimulating enough, can elevate our arousal level. In higher arousal level, the body demands more oxygen and then excretes more CO<sub>2</sub>. When arousal passes the optimal level, hypocapnia shows its undesirable effects through producing alkalosis.

Alkalosis paves the way for two main events;

1. Diminishing the amount of ionized calcium
2. Constricting the brain's blood vessels

Diminished ionized calcium keeps the neurons and muscles in an irritable state; hence numbness or paresthesia ensues especially in hands, around mouth and lips. The spasm also occurs in muscles.<sup>1</sup>

Brain vasoconstriction, on the other hand, diminishes the availability of blood to the brain and correspondingly results in symptoms such as dizziness and lightheadedness. Both groups of symptoms can change the person's sensations of internal milieu. As we know, human's self-awareness not only perceive outer environment, but also has a kind of intuitional awareness of internal events. In other words, self-awareness lies between inner and outer world and strong forces from inside put pressure on the self-awareness especially if these forces last for a long period, as it occurs in chronic anxiety disorders, irritability, or in severe and lasting emotions such as



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love, dependence, disgust, grief or irritating memories or thoughts (as in obsessional states). According to Freud's "nirvana principle",<sup>2</sup> the dominant tendency of psychic apparatus is to reduce, keep constant, or remove the internal tension due to stimulus excitation to a minimum, though nowadays the concept has been revised and substituted by the concept of keeping the excitation and arousal at the optimal level.

A very old Japanese haiku says; "If you'd like to see the moon's reflection precisely in the pond, it should be still! Otherwise, the reflection would be distorted." Zen interpreters interpret this haiku as an indication of necessity of emotional calmness and optimality of arousal for correct and precise perceiving of environment. The higher the level of arousal is, the higher the turbulence is and then the more distorted representation of world in the mind. But how this happens?

One explanation could be the occurrence of alkalosis following the hyperpnoea which follows the excitement. Alkalosis in turn causes brain vasoconstriction, and then the processing capability of brain probably diminishes which gives way to misperceiving and misunderstanding. It seems in chronic hyperexcited states such as anxiety disorders, irritability, agitated depression (as a kind of grief reaction in which the behavioral arousal is in the service of searching for the lost object) and even the severe love and longing for an object which is hard to obtain, respiratory alkalosis could be one of the main causing factors of confusion and perplexity. Then one can conclude that respiratory regulation can have a vital role in decision making times, as through the modulation of blood pH, perplexity could be removed, and the person is allowed to see the situation as close to the reality as possible. Great emphasis of ancient Gnostic traditions on respiratory regulation in reaching to clairvoyance could be an indicator that our ancestors had been implicitly aware of the importance of keeping the blood pH in control for the optimal function of our cognition. One practical

conclusion of this could be the emphasis upon learning and implementing the "respiratory control techniques" in critical situations such as important decision makings, demanding our higher clear-sightedness.

In this manner, another noteworthy point is the long term effect of respiratory alkalosis on chronic high arousal psychiatric conditions (e.g., anxiety disorders, agitated depression or hypomania) in the "sense of self" of the person. Chronic feeling of trembling tenseness (due to low ionized Calcium level) or dizziness and lightheadedness (due to cerebral vasoconstriction) can influence the afflicted person's "sense of self" and in turn alter his/her approach towards the world and the immediate environment and its ever changing nature with unpredictable stresses. Our body is the main base and platform for our awareness in the world and any lasting change in this platform, according to Maurice Merleau-ponty,<sup>3</sup> can affect its awareness, approaches to and plans for the events and problems of our environment.

Thus it seems that we should regard the blood pH and respiratory patterns in a new light because of their important role in both serious decision makings and chronic psychiatric conditions.

#### **Ethical issues**

There is none to be declared.

#### **Competing interests**

The author declares no competing interests.

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