

Procaine – Bicarbonate Infusions

5.1. Introduction

The pH of blood is kept stable within extreme narrow margins by a very intricate basal function of the organism. Through millions of years of evolution, this function has been significantly developed in mammals, and is considered to be one of the most advanced physiological functions in humans. The use of energy (oxidative processes) is always accompanied by the production of acids, through which the pH will be lowered. The intricate basal function is brought about by the interaction of kidneys, lungs, gut and skin, which will usually excrete the surplus of acidity. But, in cases of chronic disease, each biological system can be exhausted, including the acid-base equilibrium. In case of chronic viral infections and cancer, a depletion of the bicarbonate buffer can add to the catabolism and fatigue of the chronically ill, thus becoming a major risk factor for morbidity and mortality.

5.2. Acid-Base equilibrium in cancer patients

Inflammatory processes and metabolic processes in cancerous cells are associated with the generation of free oxygen radicals (FOR), even more so if these processes are chronic. Rusu *et al.* found that procaine (and its metabolite diethylaminoethanol DEAE) inhibits the generation and release of super oxide anion in a non-enzymatic system[i], and Andreadu *et al.* found that a series of ethanol amine derivatives inhibit the generation of super oxide anion radicals in a xantine-xantine oxidase system, the respective products also having a significant anti-inflammatory effect.[ii]

In normal physiological processes, FOR are released by the respiratory burst of polymorphonuclear cells (PMN), like neutrophils, macrophages and monocytes. In chronic disease, as a result of an elevated production of FOR and/or a depletion of antioxidants, FOR can induce severe alterations of cell macromolecules, expressed by lipid peroxidation, which leads to destruction of cells. It is strongly suggested by the work of Dolganiuc *et al.* that procaine and DEAE inhibit significantly the release of free radicals by PMN during a respiratory burst.[iii]

Tumor cells have a less sufficient metabolism and produce mainly lactate instead of carbodioxide and water. One could say that tumor cells do not breathe but ferment. The normal metabolism of glucose is aerobic and one molecule of glucose provides 38 molecules of ATP (energy). Under anaerobic circumstances however, one molecule of glucose will provide only 2 molecules of ATP, and instead of CO₂ and H₂O, lactate is being produced. Lactate can accumulate locally and cause pain and discomfort, like in *intermittent claudicatio*, or it can accumulate systemically and cause elevated plasma levels. Loss of appetite (*anorexia*) and wasting (*cachexia*) in cancer and in other chronic diseases, like HIV infection, can be explained, in part, by the increased need for glucose and the elevated production of lactate.

Thus, in summary, one could say that tumor cells have an increased need for glucose, which comes as no surprise, as their energy requirements are 20 times higher than those of normal cells. As a consequence, an increased use of glucose and a depletion of glycogen storage in the liver is taking place, and an abundance of lactate is consequently being produced. On the long run, the increased lactate

production will deplete the bicarbonate buffer in the blood, bring about pain and discomfort and will initiate catabolism, which will lead to *anorexia* and *cachexia*.

In the *Cologne Model*, cancer patients and patients with other (chronic) conditions, requiring support to overcome the burden of the negative effects of increased lactate production, will receive infusions with 400 ml NaCl (0.9%), 120 ml NaHCO₃ (8.4%), and 5 ml of Procaine (2%) added.

[i] Rusu C, Lupeanu E: Inhibitory effect of procain, Gerovital and Aslavital on the production of superoxide radical. Romanian J Geront Geriatrics (1989) 10(2): 117-129

[ii] Andreadu I, Reka E, Demopoulos V, Kouronakis P: Effect of some novel ethylamine and ethanolamine derivates on carrageenan induced inflammation. Correlation with antioxidant activity and structural characteristics. Research Comunic Path Pharmacology (1992) 78(2): 245-248

[iii] Dolganiuc A, Radu D, Olinescu A, Vrabiescu A: Procaine and diethylaminoethanol influence on the release of free oxygen radicals by polymorphonuclear leukocytes in rabbits and humans. Rom Arch Microbiol Immunol (1998) 57(1): 23-32