Potassium Deficiency as a Cause of Rheumatoid Arthritis

by Charles Weber

This discussion of potassium is presented in the hope that one of its readers will consider performing an experiment establishing the effect of potassium on rheumatoid arthritis. There is no report in the literature going back to 1914 of such an experiment.

Every essential nutrient should have been explored before this. In view of the way hormones which are regulated by or regulate potassium, such as cortisol and deoxycorticosterone (DOC) are involved with rheumatoid arthritis (RA), and the low whole body potassium content in Rheumatoid Arthritis (RA), potassium especially should have been investigated before now.

Introduction

Since the most serious aspect of the diarrheas is wasting potassium, cortisol has acquired the attribute of conserving potassium by moving it into the cells when cortisol declines. Cortisol (but not corticosterone) is reduced during a potassium deficiency, and this reduction accounts for many of the symptoms of RA.

Cortisol shuts down most of the copper enzymes when it declines so that excretion of copper is increased and Lysil oxidase inhibited. These last two attributes are proposed to account for most of the mortality from aneurysms and infections during rheumatoid arthritis (RA).

Thus the urgent necessity to survive during virulent diarrheas has set people up in the course of evolution for some of the worst symptoms of rheumatoid arthritis.

Discussion

Judging by the drastic decline of mortality in babies suffering from a virulent strain of diarrhea by potassium supplements,[1] potassium loss in those diseases which force cyclic AMP to excrete water into the intestines[2] must be the most serious effect of the diarrheas. I suggest that this is the reason why cortisol has acquired the attribute of moving potassium out of cells[3] and therefore into the cells upon declining. It is also undoubtedly the reason why the adrenal's cortisol secretion is inhibited by low serum potassium in vitro (in the test tube) but not corticosterone.[4] The body thus has a way of signaling for a decrease in cortisol secretion during a serious intestinal disease independently of ACTH. Thus the body inversely mobilizes defenses.

Endotoxin bacterial diseases force the body to secrete cortisol by increasing ACTH,[5] probably an adaptation by the bacteria to force the body to inhibit the immune system. Glucosteroid response modifying factor (GRMF) secreted by T-cells then prevents the cortisol from having full effect on white cells other than suppresser cells,[6] and thus raises the set point, as does interleukin-1.[5] Interleukin-1 also stimulates cortisol secretion,[7] as does cachectin (tumor necrosis factor).[8] I suspect that this is an adaptation to provide some cortisol maintenance[9] when normal ACTH production is later cut off during endotoxin attack.[10]

In other words, the immune system takes over its own regulation but at a higher set point. The role of GRMF has not yet been demonstrated for physiological processes. GRMF will probably prove to inhibit cortisol for most of those processes as well, surely at least for cortisol's various effects on potassium.

One of the most important of the cortisol controlled immune defenses is the mobilization of the availability of copper to the white cells, an attribute which probably arose because copper is crucial to an adequate immune defense.[11] The primary way cortisol does this is by, inversely to its concentration, shutting down production of copper-containing enzymes such as Lysil oxidase and superoxide dismutase.[12] Lysil oxidase catalyzes the formation of cross links in all connecting tissue including elastin.[13] Since elastin makes up the main strength of normal blood vessels[12] and has a rapid turnover, this is the most serious problem in arthritis. Ruptured aneurysms along with poor resistance to infection and heart disease are the chief terminal events in arthritis.[14]

The body uses ceruloplasmin to carry copper to the immune system during infection.[12] Probably the main reason for this development is that the copper is not in equilibrium with the serum and so is not available to pathogens. However, ceruloplasmin is also used to carry copper to the bile for excretion.[15] Therefore I submit that the rise in serum ceruloplasmin in RA[16] causes an increased excretion in members of a society who, even before this, were receiving less than the minimum daily requirement.

Conclusions

Evidence can be provided for this proposal in several ways. Arthritic people should have a lower whole body potassium content than normal people. This has been proved.[17] Red blood cells have a higher potassium content than normal during RA.[18] This should not be taken as counter evidence because I suspect that this is an adaptation to help avoid circulatory collapse when dehydration reduces the blood volume during diarrhea. There should be a lower incidence of RA among people on potassium supplementation or who eat Morton's Lite Salt™ or Stirling's Half and Half™. I know of no epidemiologic study showing this. However, people who work in potash mines have a 25% lower incidence of heart disease than the surrounding population[19] and heart disease is prevalent in RA. There should be a healing of RA upon starting potassium supplements. No controlled experiment has been reported which would indicate this. However there is a case history of a single arthritic brought up to 3.5 grams per day in order to explore the effects of various steroid hormones on the body's mineral balance.[20] A total of 3.5 grams is about the amount an adult would obtain from unprocessed food. The subject showed consistent improvement throughout the experiment even though potassium was the only consistent change. His total body potassium consistently rose. There should be a negative correlation between potassium-caused muscle spasms and RA, but I have no supporting data. Neither do I know of a positive correlation with eating licorice or potassium losing diuretics, both of which

increase potassium loss. There should be a negative correlation between eating acids which have an indigestible anion and RA since the hydrogen ion interferes with potassium excretion.[21] I know of no good experiment or epidemiologic study.

However, it has been suggested from folk custom that eating vinegar[22] or cherries is efficacious. The vinegar seems doubtful since it is my understanding that acetate can be metabolized by the body. However, it is conceivable that people on a diet high in calories do not utilize all the acetate. RA should not be present in people who eat predominantly vegetables instead of grains.

An experiment has been performed in which RA was healed in a group of people by switching to a vegetable diet.[23a]

I suspect that people with rheumatoid arthritis tend to have a poorer ability to conserve potassium than other people because of damage to their kidneys by a poison such as bromine gas or long term poisons in plant foods (such as solenaceous vegetables) or by poisons excreted by pathogenic bacteria. Screening some common poisons currently in use in food might be enlightening. Since GRMFs inhibit cortisol, it is possible that a discordance in the immune response or some infection types may accentuate RA.

If animals are used for experiments, it is futile to use rats or mice because they rely primarily on corticosterone to regulate the immune response, not cortisol. I suspect that this developed because they have a factor in their intestinal fluid which counteracts cholera toxin.[23] They also have the ability to absorb water under cyclic AMP stimulation in part of their colon[24] instead of excretion, unlike other animals.

Since the disturbance in copper metabolism is proposed as the most serious aspect of RA, evidence for copper's effect should be possible. Supplementing with copper should remove some of the symptoms of RA. I know of no such experiment.

However, it is known that Finnish men who work in copper mines have little arthritis or susceptibility to infection.[25] The high milk diet along with frequent saunas may be two reasons why other Finns have one of the highest rates of arthritis in the world,[26] since milk is the poorest source of copper[27] and perspiration loses potassium.[28] Milk has been shown to have a high statistical correlation with cardiovascular disease, said to be as great a risk as smoking,[29] which disease in turn is correlated with RA. Laplanders on a meat diet have a lower rate of RA not much further north.[26] The Massai of Africa have a higher rate of RA than the surrounding tribes.[30] The Masai also use a lot of milk as well as very few vegetables, which vegetables would have increased potassium intake. Men who work in copper mines must have stronger tissues than other miners because the percentage of injuries which result in lost time is significantly lower[31] even though injuries like eye damage and burns which are not affected by strength are part of the data. Eating a lot of shellfish or liver should reduce those symptoms related to copper- deficiency since they are the richest sources, but I know of no study. The same is true of drinking acid water out of copper plumbing.

I believe that it is unwise to give cortisol to any class of people whose immune system is weak, such as arthritic people. If it is felt that cortisol should be raised in the body, why not use something relatively safe, like potassium supplements? If potassium supplements are used, be certain that vitamin B-1 is adequate because the "wet" heart disease of Beri-Beri cannot materialize when potassium is deficient.[32] Obviously the reverse is also true for vitamin B-1 supplementation. For this reason, if the patient has heart trouble, it is very important to determine whether it is caused by vitamin B-1 or potassium. If potassium chloride is dissolved in fruit juice it tastes good and avoids the danger to the intestines that even slow release enteric tablets may present.

The chloride is the most efficacious form.[33] It would be better and safer yet to provide potassium from food high in potassium such as celery or bamboo shoots as Effinger proposed.[34] Unboiled, unfrozen, uncanned vegetables low in starch are the richest sources.[35] However, removing a deficiency will be slower since the potassium is not associated with chloride and would take a few months longer.

A deficiency can arise from diarrhea, processed food, reliance on grain or fatty foods,[35] psychic stress stimulation of aldosterone[36] (which is the main regulator of potassium),[37] stimulation of cortisol (as in an operation, for instance[38]), diurctics, licorice[39] as well as probably grapefruit,[39] profuse perspiration,[26] excessive vomiting,[40] eating sodium bicarbonate,[41] hyperventilating,[42] laxatives,[43] enemas,[44] shock from burns or injury,[45]

➤

hostile or fearful emotions,[36] and very high or very low sodium intake.[46] All of these increase excretion or decrease intake of potassium.

A chronic potassium deficiency must surely cause a degenerativc disease. I believe it materializes in some people as RA. If not, then what is the name of the degenerative disease which attends a potassium deficiency? It is not hypokalemia. This is only a word which describes low serum potassium, a marker.

Correspondence:
Charles Weber
weber@brinet.com

A more complete dicussion of the role of potassium in arthritis may be found at Weber's homepage http://members.tripod.com/~charles W/arthritis.html. Publication of this article was recommended and sponsored by The Arthritis Trust of America, 7111 Sweetgum Drive SW, Suite A, Fairview, Tennessee 37062-9384.

References

1. Darrow, D.C. 1946, Retention of Electrolyte during recovery from severe dehydration due to diarrhea, *Journal of Pediat.* 28: 515.
2. Mekalanos, J.J, Swartz, D.J.; Pearson, GDN.; Harford, N.; Groyne, F.; Wilde, M. 1983, Cholera Toxin Genes: Nucleotide Sequence, Deletion Analysis and Vaccine Developement, *Nature* 306;551.
3. Bronner, F.; Comar, C.L. 1961, *Mineral Metabolism* Vol 1, Academic Press.
4. Mikosha, A.S.; Pushkarov, LS.; Chelnakova, LS.; Remennikov, G.Ya. 1991, Potassium Aided Regulation of Hormone Biosynthesis in Adrenals of Guinea Pigs under Action of Dihydropyridines: Possible Mechanisms of Changes in Steroidogenesis Induced by 1,4-Dihydropyridines in Dispersed Adrenocorticytes. *Fiziol. ZH* (Kiev) 37:60.
5. Melby J.C.; Egdahl, R.H.; Spink, W.W. 1960 Secretion anti Metabolism of Cortisol after Injection of Endotoxin. *Journal of Lab. Clin. Med.* 56;50.
6. Fairchild, S.S.; Shannon, K.; Kwan, E.; Mishell, R.I. 1984, T-cell Derived Glucocorticosteroid Response Modifying Factor (GRMFt): A Unique Lymphokine Made by Normal T Lymphocytes and a T-cell Hybridoma. *Journal of Immunology* 132;821.
7. Besedovsky, H.O.; Del Key, A.; Sorkin, C. 1984, Integration of Activated Immune Cell Products in Immune Endocrine Feedback Circuits. p. 200, *Leukocytes and Host Defense* Vol. 5 (Oppenheim, JL; Jacobs, D.M., eds) Alan R. Liss, NY.
8. Milenkovic, L.; Rettori, V.; Snyder, G.D.; Beutler, B.; McCann, S.M. 1989, Cachectin Alters Anterior Pituitary Hormone Release by a Direct Action in Vitro. *Nat. Acad. Sci.* 86;2418.
9. Finlay, G.J.; Booth, R.J.; Marbrook, J. 1979, Antibody Responses of Human Lymphocytes in Vitro; Enhancing Effects of Hydrocortisone. *Austr. Journal of Exp. Biol. Med. Sci.* 57;597.
10. Jones, R.S.; Howell, E.V.; Eik-Nesk. 1959, Inactivation by Plasma of ACTH Releasing Property of C-14 Labeled Bacterial Polysacharride. *Proc. Soc. of Exper. Biol. Med.* 100;328.
11. Prohaska, J.K.; Lukaseqycz, O.A. 1981, Copper Deficiency Suppresses the Immune Response in Mice. *Science* 213;559.
12. Weber, C.E. 1984, Copper Response to Rheumatoid Arthritis. *Medical Hypotheses* 15;333.
13. Harris, E.D.; Rayton, J.K.; Baltriop, J.E.; Di Silvestro, R.A; Garcia de Quevedo. Copper in the Synthesis of Elastin and Collagen, p. 163, *Biological Roles of Copper*, Ciba Foundation Symposium No 79, Exerpta Medica NY.
14. Matsuoka, Y.; Obana, M.; Mita. S; Kohno, M; Irimajiri, S; Fujimori, I; Fukuda, J. Studies of Death in Autopsied Cases with Rheumatoid Arthritis. p. 27, *New Horizons in Rheumatoid Arthritis*. (Shiokawa, Y.; Abe, T.; Yamauchi, Y., eds.) Excerpta Medica Internat. Cong. Series #535.
15. Frieden, E. 1981, Ceruloplasmin: A Multifunctional Metalloprotein of Vertebrate Plasma, *Metal Ions and Biological Systems*, Vol. 13, p. 117 (Sigel, H.; Sigel, B., eds.) Marcel Dekker, NY & Basel.
16. Aiginger, P.; Kolarz, G.; Wilvonseder, R. 1978, Copper in Ankylosing Spondylitis and Rheumatoid Arthritis. *Scand Joumal of Rheumatol.* 7;75.
17. LaCelle, P.L., et al. 1964, An Investigation of Total Body Potassium in Patients with Rheumatoid Arhritis. Proc. Ann. Meeting of the Am. Rheumatism Assoc. *Arth. Rheum.* 7;321.
18. Knudsen, E.T.; Thomas, M.J. 1957, Erythrocyte Potassium Level in Rheumatoid Arthriris. *Lancet* 272;251.
19. Waxweiler, R.J., et al. 1973, Mortality of Potash Workers. *J. Occup. Med.* 15;486.
20. Clark, W.S. et al. 1956, The Relationship of Alterations in Mineral and Nitrogen Metabolism to Disease Activity in a Patient with Rheumatoid Arthritis. *Acta Rheum. Scand.* 2;193.
21. Berliner, R.W., et al. 1951, Relationship between Acidication of the Urine and Potassium Metabolism. *Amer. Journal Med*, 11;274.
21a. Mills, J.H.; Stanbury, S.W. 1954, A Reciprocal Relationship between K+ and H+ Excretion in the Diurnal Excretory Rhythm in Man. *Clin. Sci.* 13;177.
22. Jarvis, D.C. 1960, *Arthritis and Folk Medicine*. Pan Books Ltd. London.
23a. Kjeldsen-Kraw, J 1991, *Lancet* Oct 12;899.
23. Donowitz, M.; Binder, H.J. 1976, Effect of Enterotoxins of Vibrio Cholerae, Escherichi coli, & Shigelladienteriae Type 1 on Fluid and Electrolyte Transport in Colon. *Journal of Infect. Dis.* 134:136.
24. Hornyck, A.; Meyer, P.; Milliez, P. 1973, Angiotensin, Vasopressin, and Cyclic AMP: Effects of Sodium & Water Fluxes in Rat Colon. *Am. Journal of Physiol.* 224;1223.
25. Sorrenson, JRJ; Hangarter, W. 1977, Treatment of Rheumatoid and Degenerative Diseases with Copper Complexes. *Inflammation* 2;217.
26. Kellgren, J.H. 1966, Epidemiology of RA, *Rheum.*9;658.
27. Underwood, E.J. 1972, *Trace Elements and Human and Animal Nutrition*. Academic Press NY.
28. Consolazio, C.F., et al. 1963, Excretion of Sodium, Potassium, Magnesium, and Iron in Human Sweat and the Relation of Each to Balance and Requirements. *Journal of Nutr.*, 79;407.
29. Seely, S. 1981, Diet and Coronary Disease: A Survey of Mortality Rates and Food Consumption Statistics of 24 Countries. *Med. Hypotheses.* 7;907
30. Best, C.H.; Taylor, N.B. 1950, *The Physiological Basis of Medical Practice*, 5th ed. Williams and Wilkins Co., Baltimore (P-768).
31. US Dept. of Labor, Mine Safety and Health Administration. 1981, Injury Experience in Metallic Mineral Mining, 1R 1142 Table #6 pp. 24 & 58.
32. Folis, RH. 1942, Myocardial Necrosis in Rats on a Potassium Low Diet Prevented by Thiamine Deficiency. *Bull Johns-Hopkins Hospital* 71:235.
33. DeLand, E.C., et al. 1979, A Theoretical and Experimental Study of Ionic Shifts Induced by K Depletion and Replacement. *Journal of Theor. Biol.* 76;31.
34. Eppinger, H. 1939, Einiges Uber Dietetische Therapie. *Ztschr. F. Artzl. Fortbild.* 36; 672 & 709.
35. Weber, C.E. 1974, Potassium in the Etiology of Rheumatoid Arthritis and Heart Infarction. *Journal of Applied Nutrition*, 26;41 (Bibliography published separately).
36. Glaz, E.; Vecsei, P. 1971, *Aldosterone*, Pergamon Press NY (p 209).
37. Weber, C.E 1983, Corticosteroid Regulation of Electrolytes. *Journal of Theor. Biol.* 104;443.
38. Elman, R., et al. 1952, Intracellular and Extracellular Potassium Deficits in Surgical Patients. *Ann. Surgery* 136;111.
39. Stormer, FC, Reislad, R, Alexander, 1993, Glycyrrizic acid in licorice - evaluation of health hazard. *Food Chem. Toxicol* 31;303-312.
39a. Lee YS, Lorenzo, BJ, Koufis, T, Reidenberg, MN 1996, Grapefruit juice and its flavonoids inhibit 11 beta-hydroxy steroid dehydrogenase. *Clin. Pharmacol. Ther.* 59;62-71.
40. Barter, F.C. 1980, Clinical Problems of Potassium Metabolism, Contributions to Nephrology. p. 21, *Disturbances of Water and Electrolyte Metabolism*. Bahlmann, J.; Brod, J., eds. S. Karger, Basel.
41. Berliner, R.W, et al. 1951, Relationship between Acidification of the Urine and Potassium Metabolism. *Amer. Journal of Med.* 11;274.
42. Kilburn, K.H. 1966, Movements of Potassium during Acute Respiratory Acidosis and Recovery. *Journal of Applied Physiol.* 21;679.
43. Schwartz, W.B.; Relman, M.B. 1953, Metabolic and Renal Studies in Chronic Potassium Depletion Resulting from Overuse of Laxatives. *Journal of Clin. Invest.* 32;58,
44. Dunning, M.F.; Plum, F. 1956, Potassium Depletion by Enemas. *Amer. Journal of Med* 20;789.
45. Fox, C.L.; Baer, H. 1947, Redistribution of Potassium, Sodium, and Water in Burns and Trauma and Its Relation to Phenomena of Shock. *Am. Journal of Physiol.* 151.
46. Williams, G.H.; Dluhy, R.G. 1972, Aldosterone Bio-synthesis: Interrelationship of Regulatory Factors. *Am. Journal of Med.* 53;595.