

## Mercury and Thiols (from Toxic Timebomb 1<sup>st</sup> edition pp74-78)

Once inside the body, where does the mercury go? More importantly, I suppose, would be the question of how mercury moves around in our bodies. It travels by way of biological pathways. In effect, these pathways represent the "road maps" that provide routes for different substances to move along in getting from one point to another.

Scientists have established the fact that mercury has an affinity or attraction for thiols. A thiol is any organic compound containing a univalent radical called a sulfhydryl and identified by the symbol -SH (sulfur-hydrogen). What this really is saying, is that a thiol can attract one atom of mercury in the ionized form and have it combine with itself. It also means, because it is a radical, that it can enter into or go out of this combination without any change.

1. Tissue cell receptor sites. Whenever cysteine is present on the exterior of a cell membrane, the potential exists for combining

2. Hormones and Enzymes. All are proteins, so those with a readily accessible thiol group have the capability of combining with the mercury ion.

3. Erythrocytes. These are our red blood cells and they have a hemoglobin content which transports oxygen and iron. Hemoglobin contains 60 times as much thiol as does the human blood plasma. This fact gives it a high potential for combining with the mercury ion. In fact, anemia is frequently encountered in those individuals suffering from mercury intoxication. (anemia represents a reduction in the number of red blood cells contained in 100 milliliters of blood)

4. Glutathione. This is a protein having a specific combination of 3 amino acids, which is called a tripeptide. The important thing here is that one of the amino acids is cysteine with its thiol group and that glutathione is present in high concentrations in all cells. There is quite a bit of research going on at the present time, exploring glutathione and its functions, particularly in its role with selenium and mercury. Both of these metals can bind to the thiol group of glutathione. In fact, both are competing for the same binding sites. The difference being that when selenium combines with glutathione it becomes an essential component of several enzymes in the body, and when mercury binds to glutathione it tends to inhibit or prevent these same enzymes from being formed.

One enzyme in particular that mercury affects is glutathione peroxidase. This enzyme is very important to us because it helps combat or neutralize certain substances (that are normal byproducts of metabolism), that, if not controlled would destroy a great number of our cells. When our bodies are deficient in selenium it also means that there is less selenium available to compete with the mercury and, as a result, more mercury ions will bind with the glutathione. This can only serve to aggravate a bad situation.

Another very important discovery was that one of the enzymes necessary to make insulin work in our bodies is made from glutathione. In one form of diabetes, the body has plenty of insulin available, however, it doesn't seem to have any effect on controlling the blood sugar level. Some researchers are currently looking into the possibility that the presence of mercury combined with the enzyme prevents it from doing its normal job of making the insulin active. As you can see, the large amount of glutathione available in our bodies provides a great thiol pathway for mercury.

5. Coenzyme 'A' and Succinyl Coenzyme 'A'. These are considered by some to be the most important enzymes in the human body and are intimately involved in the way the body converts (metabolizes) glucose (blood sugar) into energy. Because thiol groups are present, we also have the potential pathway for mercury. This, of course, could then have an impact on our energy levels because the mercury has the capability of disrupting or reducing the amount of energy we can produce from glucose.

6. Myosin. Myosin, which contains thiol groups, is the most abundant protein in our muscles. Together, with another protein called Actin, they are responsible for the contraction and relaxation of muscle. The importance of this is that with the thiol group ~ present in our muscles, it then makes it possible for the mercury ~] ion to also be present. The presence of mercury could possibly affect the normal sequence of contraction and relaxation, disturbing the rhythm and causing problems in muscle control. One of the side effects of this action could be tremors, which also happens to be a frequent symptom of mercury intoxication.

7. Cholinergic receptors in heart muscle. As we discussed in an earlier chapter, nerve impulses travel along segments of nerve fibers. To get from one segment of nerve to the next one, the impulse has to get across the synapse, or junction, of the two nerve endings. One group of nerves allows the impulse to "fire" across the junction through the use of a substance derived from choline which is called acetylcholine. Acetylcholine, in effect, becomes a bridge across the junction of the two nerves permitting the impulse to get across. However, every impulse that goes across the junction, uses up the acetylcholine that was in the junction. So before another impulse can get across, some more acetylcholine has to be manufactured and placed back in the junction. This requires a special enzyme which has a thiol group. Therefore, we are once again looking at a potential thiol/mercury pathway; only this time, it is involved with our nerve transmission system.

One way our heart muscles get nerve impulses transmitted to them, so that they can stay regulated, is through the cholinergic receptors (which also contain thiol groups) of the acetylcholine nerve system. So, anything that could inhibit or reduce the effectiveness of the enzyme that makes the acetylcholine, could also possibly affect our heart beat. Scientists know that the mercury ion can combine with the thiol group in the enzyme that makes acetylcholine and reduce the amounts available for insuring continuous uninterrupted transmission of nerve impulses.

Remember also, that the myosin in our heart muscles is responsible for contraction and relaxation dependent upon the nerve impulse received, and that this too, is where the mercury ion can cause a mixup of signals.

All three of these mechanisms, operating together, could possibly be the reason that an irregular heart beat is a frequently seen symptom in mercury toxicity.

8. Factor XIII. This is a protein that is involved in the processes of blood coagulation. As you can imagine, because of its coagulation function in our blood, Factor XIII is available throughout our entire body: outside our red blood cells in the plasma; inside our red blood cells, and also in the placenta. Factor XIII is normally not active and is only activated when there is a need to assist in controlling normal coagulation of the blood, wound healing, placental retention, etc. In its activated form it is designated as Factor XIIIa and in this form it is characterized as a thiol enzyme. This again means we have another potential mercury/thiol pathway.

There is some extremely exciting research being done regarding this compound. One recent

paper demonstrated that mercuric ions can react with Factor XIIIa, resulting in inhibition of its activity. Because of this, there have been some theories advanced that it may possibly be involved in tumor growth and metastasis.

9. Thioredoxin. This is another protein in the body that has pairs of thiol (-SH) groups attached, which of course makes it another potential mercury/thiol pathway. This particular protein is extremely important to us because it is intimately involved in the creation of DNA. DNA (deoxyribonucleic acid) is the carrier of all the genetic information of a cell. Without DNA, the cells could not reproduce exact copies of themselves. Researchers have shown that mercury, when combined with the thiol groups in thioredoxin, can cause an inhibition of the enzyme that results in its inactivation, which they have been unable to reverse.