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Venu Gopal, MD
Chief Forensic Pathologist
County of Fresno
760 West Nielsen Avenue
Fresno, California, 93706
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March 26, 2001

Concerning: Linda Adanalian

Dear Dr. Gopal:

I have read your letter of March 23, 2001 and reviewed the Autopsy Report and medical history of Linda Adanalian.

Based on the serum and tissue selenium levels observed, acute and chronic selenium poisoning can be ruled out. This conclusion is consistent with the absence of other signs characteristic of acute selenium poisoning, such as the absence of garlic smell, discoloration of the skin or internal organs, hair loss and nail changes.

Ante mortem plasma Se of 90 µg/L is within normal limits. Postmortem blood Se level of 38 µg/dL = 380 µg/L is within normal limits. Liver and kidney Se as determined for wet tissues are also within normal limits. The somewhat higher levels reported for the dry liver, kidney and lung are still within normal limits.

The literature¹ lists values from 1.73-2.40 µg/g for liver, 2.05 - 3.5 µg/g for kidney, 0.84 - 1.1 µg/g. No Se values for dry spleen have been reported, but since wet spleen tissue may contain from 0.04 - 0.30 µg/g, the observed values for dry tissue are within the expected range for normal subjects. In addition, the observed hair Se of 0.353 - 0.47 µg/g is indicative of the absence of a chronic selenium intoxication.

For your information, in one published case of fatal selenium poisoning², blood selenium levels were 38 µg/ml = 38000 µg/L (!), or 100 times higher than reported for Linda Adanalian. In this case, the liver (wet weight) contained 741 µg/g, the kidneys 450 µg/g, the spleen, 1090 µg/g.

In summary, acute selenium intoxication can be safely excluded.

G.N. Schrauzer
G.N. Schrauzer, Ph. D.

¹G.V. Iyengar, W.E. Kollmer, H.J.M. Bowen. "The Elemental Composition of Human Tissues and Body Fluids. Verlag Chemie, Weinheim, New York, 1978.
²C. Köppel, H. Baudisch, I. Klöppel, V. Schneider. "Fatal poisoning with selenium dioxide. Clinical Toxicology 24(1) 21-35 (1986).



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April 16, 2001

Venu Gopal, M.D.
Fresno County Coroner's Office
760 West Nielson Ave.
Fresno, CA 93706

Dear Dr. Gopal:

I received your letter of March 23, 2001, along with the description of the illness of Linda Adanalian. You asked me to comment on the possibility that she died of selenium poisoning. I have been involved in the selenium research field for over 30 years and have had the opportunity to consider cases of selenium poisoning previously.

Normal concentrations of selenium in plasma in the United States range from around 80 to 250 micrograms per liter. In blood, the values are generally from 100 to 250. Normal tissue levels of selenium are generally in the range of 0.2 micrograms to about 2-3 micrograms per gram of wet tissue. The plasma value that you got was 90 micrograms per liter. This is in the normal range. The postmortem blood specimen was 380 micrograms per liter. This is at the upper limit of the normal United States range. Wet liver samples were 0.46 micrograms per gram and 1.48 micrograms per gram. Wet kidney samples were 0.53 micrograms per gram and 1.02 micrograms per gram. The only selenium value that is above the usual United States range is the post mortem blood sample. It is really at the upper limit of what we consider to be normal in the United States. However, people in other countries have levels this high and even much higher without manifesting selenium toxicity. Thus, I would not consider this to a toxic level. The tissue levels you report are entirely within the normal range.

If the patient had been poisoned acutely with selenium, I would expect there to have been much higher levels of selenium in the blood and in the tissues of the body. The values that you have obtained indicate that no selenium poisoning, acute or chronic, took place in this case. Selenium is volatilized from the body when it is present in high concentrations. However, it is not volatilized or lost to the extent that the tissue and blood levels would be in the non-toxic range as these are. Thus, I think we can rule out the possibility that selenium was lost from the body after death.

My final opinion is that there is no evidence of selenium poisoning in this case. If you require any further opinion or information from me, please let me know.

Best regards.

Sincerely yours,

Raymond F. Burk, M.D.
Professor of Medicine and Pathology

RFB/ka

1522 Harvard Avenue
Salt Lake City, Utah 84105

May 7, 2001

Venu Gopal, MD
Chief Forensic Pathologist
Fresno County Coroner's Office
760 West Nielson Avenue
Fresno, CA 93706

Dear Dr. Gopal:

I have reviewed the case file concerning the death of patient Linda Adanalian, and I find it very unlikely that this represents a case of selenium poisoning.

On the page titled "Summary of Laboratory Results of Selenium Concentrations", the antemortem plasma specimen is the most reliable. The value of 90 µg/L is within the normal plasma reference interval of 20-190 µg/L (different laboratories may use slightly different intervals), and is sufficient by itself to exclude selenium poisoning.

I do not have a good reference interval for postmortem blood, in part because such specimens are notorious for introducing artifacts. The antemortem plasma reference intervals are not applicable since a variable number of blood cells are included, depending on how the postmortem specimen was collected.

The elevated selenium concentrations in the tissue specimens are most likely due to exogenous contamination. As you know, trace element analysis is very prone to such problems. I would emphasize that it would never be possible to exclude exogenous contamination particularly if the tissue was collected after exhumation.

Concerning the clinical presentation, I believe the relatively slow onset of symptoms makes acute selenium poisoning unlikely. Most published cases of acute selenium poisoning describe a more rapid progression (e.g., C Koppel et al. in J Toxicol 1986; 24: 21-35).

Thank you for the referral. I have included a copy of my CV so you may review my background.

Sincerely,



Kern Nuttall, MD, PhD
Consultant in Laboratory Medicine

cc: Dr. Todd Glauser