MERCURY INTAKE FROM DENTAL AMALGAM FILLINGS

By

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How ludicrous the dental profession of the United States must appear to the public and to the toxicology experts of the world!

While our dental educators devote their energies to arguing mathematical equations, world experts and governments are concluding that any exposure to mercury from dental amalgam fillings is undesirable for the public.

The imbroglio seems to have started with the research of Vimy and Lorscheider, attempting to quantify the contribution of mercury vapor to the accumulation of mercury in the bodies of subjects. In their first two studies (8,9), Vimy and Lorscheider measured intra-oral mercury vapor levels before and after stimulation and estimated daily mercury vapor intake in subjects with various numbers of amalgam fillings. In their third published study (10), Vimy and associates attempted to predict the accumulation of mercury in the body and its compartments over periods of time at the exposure levels found in their previous studies. Previous published research had merely established, albeit firmly and conclusively, that patients were being exposed to mercury from dental amalgam fillings without attempting to quantify that exposure in terms of intake and accumulation.

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Did the pro-amalgam forces prove that Vimy and associates, as well as the numerous other researchers, were wrong by presenting documented research demonstrating that patients are NOT being exposed to mercury from their amalgam fillings. No, of course not! Why not? Because there is no research establishing that position, nor is it possible to have any! Patients ARE being exposed to mercury from their amalgam fillings and that daily exposure results in the accumulation of mercury in their bodies with time. These scientific realities have been confirmed by three separate published autopsy studies and are therefore inescapable and unarguable!

Instead of disproving the scientific reality of the findings of Vimy and associates, the pro-amalgam forces have attempted to belittle their conclusions by challenging their mathematical agility.
The anticipated culmination of this counter-attack was the opinion paper entitled "Factors Affecting Estimation of Dental Amalgam Mercury Exposure from Measurements of Mercury Vapor Levels in Intra-oral and Expired Air" by J. R. Mackert, Jr (1987). We call this an 'opinion paper' deliberately because Dr. Mackert, in his vain attempt to discredit Vimy and associates, has himself committed several glaring omissions that reflect his lack of objectivity and knowledge of the subject.

Dr. Mackert challenges the calculations of Vimy et al., claims that they overestimate the daily dose of mercury from amalgam fillings by a factor of at least 16, and concludes "the contribution of dental amalgam to total daily intake of mercury is seen to be minor".

The rationale presented by Dr. Mackert encompasses such profound physiological health parameters as sampling time, size of the sampling tube, air departure paths, flow rates, mouth geometry and the length of time the air spends in approximation to the amalgam fillings; all of which leads to his uniquely accurate determination of 'mercury vaporization rate' from the amalgams from which he calculates the daily intake. Although Dr. Mackert is obviously impressed with his own knowledge of physics, this pride has prevented him from noting the blatantly obvious fallacy in his own calculations, which were pointedly derived from the data of Vimy and associates (Table 2 and Discussion, page 1778, reference #4) and specifically intended to discredit those authors. Had Dr. Mackert been forthright and thorough, he would have reiterated the intention of Vimy et al. to simply estimate the mercury vapor intake from three meals and three snacks per day without consideration of the influence of various habits (such as gum chewing), body size and weight, and THE CONTINUOUS INHALATION OF MERCURY VAPOR 24 HOURS A DAY!

Data from a number of published research studies has clearly demonstrated that mercury vapor is released from amalgams constantly and that the release is simply increased by stimulation, and that it takes at least 90 minutes to return to the pre-stimulated baseline release levels. Although the pre-stimulated levels of mercury vapor in the oral cavity may be low, the average number of inhalations per day is 17,280 (12 breaths per minute x 60 minutes x 24 hours). Considering a 24 hour oral/nasal breathing ratio of only 35%, if only 1 nanogram per breath were inhaled and 80% of that is absorbed in the lungs alone, the intake would be 4.84 micrograms per day, without even considering any meals, snacks or habits. The USEPA standard for adults limits the daily intake of mercury from all sources other than diet to 20 micrograms per day.(7) Is 1 nanogram per inhalation an unreasonable assumption? Since the volume of the average oral cavity is roughly 50 ml (cc), the concentration of mercury would be only 0.02 micrograms Hg/cubic meter. According to data from published studies, unstimulated baseline mercury vapor measurements in subjects with amalgams far exceed that level.

Dr. Mackert, then, has pointedly ignored the obvious - that patients are exposed to mercury from dental amalgam fillings 24 hours a day. One must wonder whether his intention was to scientifically evaluate that exposure, or merely to attempt to discredit the work of Vimy and associates.

A forthright and scientific evaluation of patient exposure to mercury from dental amalgam fillings would have to encompass three factors with scientific data available and three factors which would have to be estimated. The three factors with available scientific data are:

1. Baseline unstimulated mercury vapor intake.
2. Mercury vapor intake resulting from 3 meals and 3 snacks daily.
3. Ionic mercury intake from ingestion.

**BASELINE UNSTIMULATED MERCURY VAPOR INTAKE:**
This is the obvious starting point in the determination of patient exposure to mercury from amalgam fillings. Utilizing data from existing published research studies, we attempted to evaluate this intake in a previous issue of the Bio-Probe Newsletter.(1)
In a 1987 study, the Swedish Board of Occupational Safety and Health also evaluated this basic intake. They found the baseline exposure to be 500 micrograms per week, which unfavorably compared to WHO standards. Consideration of absorption rate and oral/nasal breathing ratio would be utilized to calculate intake.

In their 1988 publication, Clarkson and associates also evaluated baseline unstimulated mercury vapor intake from the data available in four published research studies. Their findings were 0.8-1.8 micrograms per day of intake. In this report, levels were calculated from the determination of a release rate of the mercury vapor from the amalgams (as did Mackert in his study). It would seem that another approach might be to simply determine the mean unstimulated concentration in subjects over a 24 hour period and determine intake based on the number of oral inhalations per day, which obviates the complicated mechanizations of evaluating release rates from the fillings. This still would not account for intake from other routes, such as ingestion and mucosal absorption.

**MERCURY VAPOR INTAKE FROM 3 MEALS AND 3 SNACKS DAILY:**

Regardless of criticisms from select individuals relating to mathematical computations, the research of Vimy and associates has provided the raw data for this evaluation. Another attack has been directed at Vimy et al. for their utilization of intra-oral mercury vapor detectors; the claim being that these units vastly overestimate the mercury vapor concentration in so small a sample. Were this criticism valid, studies utilizing other sampling techniques would demonstrate far lower concentration values. Quite the contrary is true! There have now been at least six studies published measuring mercury vapor release from amalgam fillings (not counting the early studies by Stock), only two of which utilized mercury vapor detectors. All of the studies, regardless of technique, discovered mercury vapor levels in the same general range. LET THE CRITICS EXPLAIN THAT ONE!

Dental authorities will no doubt debate the mathematical computations for many months to come. For the time being, it seems most prudent to accept the evaluation of world-renowned toxicology experts, Thomas W. Clarkson and associates. Utilizing raw data from four published research studies, they computed the daily intake of mercury vapor from amalgams to be 1.6-15.7 micrograms during function and the total intake to be 2.5-17.5 micrograms per day. Note that this is solely from the inhalation of mercury vapor released from the amalgams, not considering intake from ingestion and mucosal absorption.

**IONIC MERCURY INTAKE FROM INGESTION:**

There have been a number of published studies evaluating the ionic release of mercury from amalgam in various test solutions over various time periods. Most of these studies suspended amalgam samples by string into test solutions and measured mercury release under static (no function) conditions. It has been firmly established that mercury release in natural saliva is much higher than in artificial test solutions.

Only one study evaluated ionic mercury release from both static and dynamic (functional) conditions, that of Brune and Evje. They found that subjects with 20 surfaces of amalgam would have an INTAKE of 18 micrograms of mercury per day.

According to scientific data now published, evaluation of mercury intake from amalgams under the previous three conditions can now be accomplished. One conclusion can certainly already be established - THIS INTAKE IS BY NO MEANS INSIGNIFICANT!!! This is exactly the position now being taken by the world's leading toxicology experts and a number of governments outside of North America. Moreover, there are three additional factors so far lacking in hard data but which require consideration nonetheless:

1. Absorption of mercury into the oral and dental tissues: This has been well established in the literature, but the quantification of this exposure has not been determined.
2. Direct passage of mercury from the oral and nasal cavities to select areas of the brain via the valveless veins and/or the axon transport system of nerves: This phenomenon was first described by Stock some 60 years ago. It is now being investigated by Swedish researchers, particularly Dr. Patrick Störtebecker and Dr. Magnus Nylander. The implications of this phenomenon could be extremely dramatic.

3. The influence of personal habits and body size: There cannot be any doubt that children would require special consideration when subject to mercury in amounts equal to adults. It is also obvious that certain personal habits would have a dramatic influence on mercury release from amalgam fillings. These would include chronic gum chewing, oral versus nasal breathing, bruxing, smoking, and use of acidic beverages (soda pop, citrus juices, etc.). Patterson et al. demonstrated mucosal absorption in nasal exhalation.(5)

We are certain that Dr. Mackert and other dental researchers and authorities are responsible individuals who have no desire to be considered lacking in their perception of mercury released from dental amalgams and its influence on the recipient patients. History is a harsh judge, indeed! It is our hope that this dissertation will be of some assistance to these individuals in determining their future public statements on this subject.

REFERENCES


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ABSTRACTS/REVIEWS


BIO-PROBE REVIEW:

This study demonstrates the teratogenic effects possible when methylmercury interacts with mitomycin-C, a cancer chemotherapeutic drug. It also raises the question whether similar potentially dangerous interactions are feasible and applicable to amalgam bearers being prescribed and administered various pharmaceuticals.

In their study, utilizing pregnant mice, Inouye and Kajiwara determined the effects of teratogenic doses of mitomycin-C administered alone or administered after the animals had been given non-teratogenic doses of methylmercuric chloride.

Major malformations produced by mitomycin-C alone were cervical rib and vertebral anomaly, polydactyly of the hindlimb and tail anomaly. When both mitomycin-C and methylmercury were present in the combined treatment the same malformations were significantly increased, demonstrating a dose-effect relationship of methylmercury. A considerable number of fetuses showed cleft palate involvement following combined treatments, but not by either chemical alone. Cleft palate is known to be a major malformation in mice that is caused by methylmercury, and mitomycin-C also induces cleft palate. Therefore, the two chemicals might have affected fetuses additively.

BIO-PROBE COMMENT:

Two thoughts: 1. We are all subjected to environmental and dietary methylmercury to some degree. Does that place amalgam bearers at greater risk from potentially dangerous drug interactions with both inorganic and organic mercury? 2. Does the potential of mercury/drug interaction have a dose-dependent relationship in other health conditions where an individual may be on as-many-as 5-10 different drugs simultaneously, each with its own compounding or interacting set of toxic side effects?

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BIO-PROBE REVIEW:

Chen and Preston stated that the major route for distribution of ingested heavy metals throughout the body is via the blood and that because of this the behavior of heavy metals in the blood probably has a general impact on many other organ systems. Previous studies on the distribution of heavy metals in body tissues have indicated that blood cells tend to accumulate heavy metals eventually establishing significantly higher levels in the cells when compared with serum. Mercury as a rule acts as a sulfhydryl reagent suggesting that the mechanism of toxicity is the chemical modification of cellular sulfhydryl groups, ultimately leading to disruption of normal cellular function.

The objective of the study by Chen and Preston was to characterize the effect of mercury exposure on the transport of the amino acid, taurine, by the hemoglobin containing red blood cells of the marine polychaete, Glyceria dibranchiata. The authors cited research indicating that taurine appears to participate in the osmoregulation of mammalian heart and brain tissues.
with progressive systemic sclerosis (PSS) described in earlier studies by Passaleva et al. (1986) and Berstein, Steigerwald & Tan (1982). Hultman & Enstrom concluded by saying that their findings suggest that exposure to mercury might lead to development of autoantibodies in humans.

**BIO-PROBE COMMENT:** There are, of course, anecdotal case histories demonstrating abatement or cures of some of the diseases determined to be of an autoimmune nature, through the simple act of amalgam replacement with non-metallic materials. What is needed now is for some well-documented medical studies of amalgam bearers demonstrating the presence of mercury in patients suffering from lupus-like disease; the numbers and surfaces of amalgam fillings; replication of the medical documentation after amalgam replacement; and medical documentation of any symptom change.

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**SUMMARY:**

Mercuric chloride induces in Brown-Norway rats an autoimmune disease characterized by the production of various autoantibodies and by a marked increase in the IgE serum concentration. This agent is responsible for a T dependent polyclonal activation of B cells, which is probably due to the emergence of autoreactive T cells. The aim of this study was to evaluate the effect of HgCl₂ injections on lymphoid organs and on the serum concentration of the various Ig isotypes. HgCl₂ induced (1) a lymphoproliferation in spleen and lymph nodes involving B and T helper cells while the number of T suppressor/cytotoxic cells was not modified, (2) an increase in the number of Ig containing cells resulting in a rise in all serum Ig isotypes, and (3) an early thymic atrophy probably immunologically mediated, which was not involved in the induction phase of the disease since adult thymectomy had no effect. These findings demonstrate that the polyclonal effect of HgCl₂ is not isotype-restricted although the IgE response is predominantly affected and they support evidence for a major role for an excess of T help in the HgCl₂-induced polyclonal activation of B cells. It was also observed that B cell areas are present in normal BN rat thymuses, the potential role of which in the induction of autoimmunity remains to be investigated.

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**BIO-PROBE REVIEW:**

The authors of this paper felt that the divergent opinion as to the relationship between mercury air/urine ratios may possibly have resulted from failure to consider clothing contamination and sweating. They designed a series of tests with chlor alkali mercury cell workers whereby rubber chest waders were used to capture sweat accumulated during normal work function. The test was limited to 1 1/2 hours after which time the sweat was drained from the waders. Volume and specific gravity were determined. Samples were further analyzed for mercury content. The results of this evaluation were then compared to special 16-hour composited urine samples previously analyzed.

"The concentration of mercury in the sweat was considerably higher than that in the urine on a comparable volume. The quantity of mercury eliminated in sweat within the 1-1/2 hour period represented
from 50% to 200% of that contained in the 16-hour composite urine sample for the mercury cell circuit participants. The individual with the sweat rate also had the highest mercury concentration in his sweat."

The authors felt that the elimination of mercury via sweat represented a significant route for removal of mercury from the body. Further, because the mechanisms involved in sweating bypass the kidney’s role in the elimination of mercury as opposed to use of BAL, N-acetyl-d, l-penicillamine and calcium EDTA, sweating should be the initial and preferred treatment of patients with elevated mercury urine levels.

**BIO-PROBE COMMENT:**

A very simple study could be done by collecting and analyzing the sweat of amalgam bearers as opposed to controls with virgin teeth. The results could be startling!

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ABSTRACT: A study of 162 dentists’ and their assistants’ mercury levels in hair and urine, and of questionnaire items regarding mercury consumption, revealed some striking relations. The mercury concentrations in both hair (Hg-H) and urine (Hg-U) were somewhat higher in the dentists than the assistants. There was no relation between concentrations in hair and urine. The method of condensation of amalgam was positively related to Hg-U; the vibration method was negatively related. Hg-U was also positively related to number of fillings and hours in own practice. The relation of Hg-U to ventilation in the surgery applied only to the dentists.

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ABSTRACT: Mercury exposure and renal function parameters were examined in 68 dentists and 64 dental assistants. The levels of mercury in urine were low: only three individuals exceeded 20 micrograms/l. Increased excretion of urinary proteins and increased activity of urinary enzymes were observed. This enhanced prevalence of renal function changes appeared not to be related to the mercury urine level, age, sex, or smoking and drinking habits. Only for men was a positive relation between the level of mercury in urine and the activity of beta-galactosidase found. The proteinuria may be due to one or more potential nephrotoxic agents used in dental practice.

**BIO-PROBE COMMENT:** Further evaluation of the above two studies will be reported on in Bio-Probe after receipt of the full studies.

**FORUM**

The International Academy of Oral Medicine and Toxicology Annual Meeting and Scientific Symposium being held in Oakbrook Illinois on Sept 16-18, 1988 is going to be video taped by a commercial production company. Bio-Probe will issue a special flyer on the subject after reviewing the tapes. At the present time it is anticipated there will be six different video tapes covering two days of scientific presentations. There will also be a full set of audio tapes available.