BIO-PROBE
NEWSLETTER

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ORIGINAL ARTICLE
DIETARY MERCURY VS AMALGAM MERCURY
A RED HERRING ?????
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The intention of this discussion is not to minimize the seriousness of mercury derived from the diet, but rather to place it in a rational scientific perspective compared to mercury exposure from dental amalgam fillings.

A number of individuals, in an attempt to justify continued use of mercury/silver dental amalgam filings, have claimed that patient exposure to mercury from amalgam fillings is trivial compared to mercury intake from the diet, which is predominately methyl mercury derived from fish.

The position has been based on two premises: 1) The amount of mercury patients receive from dental amalgam fillings is negligible compared to the amount of methyl mercury received from the diet; and 2) methyl mercury derived from fish is more toxic than mercury vapor derived from dental amalgam fillings.

As we shall now see, both of these premises are contradicted by valid scientific documentation and are, therefore, false!

COMPARATIVE INTAKE

DIETARY MERCURY: Worldwide, a number of studies assessing the volume of intake of mercury from the diet have been done. In the United States, the Environmental Protection Agency (USEPA) determined that the average intake of mercury from the diet did not exceed 10 micrograms per day for the 154 pound adult. (1) This estimate is actually high, since the data provided by the USEPA in that document showed the average intake of mercury due to fish consumption to be 4.7 micrograms of mercury per day.

In 1988, Clarkson and associates stated that the average mercury intake from the diet in the U.S.A. was 2-7 micrograms per day for adults, 1 microgram per day for
toddlers, and less than 1 microgram per day for infants. (2)  

SUMMARY = 2-10 MICROGRAMS PER DAY FOR ADULTS.  

DENTAL AMALGAM MERCURY: There are four routes by which mercury released from dental amalgam fillings enters the patient’s body:  

1. Inhalation of released mercury vapor.  
2. Gastrointestinal absorption of mercury dissolved in foods and fluids.  
3. Absorption of mercury through the mucosa of the oral (especially the gingival tissue) and nasal cavities.  
4. Passage of mercury through the dentinal tubules of teeth into the blood vessels of the pulp and hence throughout the body. 

Although the latter route has been scientifically demonstrated, there is absolutely no data available upon which conclusions can be drawn defining the amounts of mercury absorbed. Further although data is just starting to appear on absorption through the oral mucosa, the data is insufficient for inclusion in our intake calculations. There is, however, published data allowing definition of intake from the former two routes. 

1. Inhalation of released mercury vapor: Several basic studies have been published that provide data allowing quantification of intake from mercury vapor released from dental amalgam. The recently published (February 1988) text "Biological Monitoring of Toxic Metals" devotes an entire chapter to this topic. (3) The authors are the world’s leading experts on mercury toxicology; their credentials being beyond reproach. Based on data provided by four published basic studies, the authors calculated intake of dental amalgam mercury vapor derived from three meals per day (functional release) and the static release the remainder of the day. Their determinations were = 2.5 to 17.5 mcg/day. Bear in mind, this determination included only inhaled mercury vapor!  

SUMMARY = 2.5 - 17.5 MCG/DAY BY INHALATION.  

2. Ingestion of dissolved mercury: A number of studies have been published that demonstrate the dissolution of mercury in various test solutions. Care must be exercised in evaluating these studies because it has now been proven that mercury release in natural saliva is much greater than in artificial saliva. (4,5) In these studies, amalgam samples were suspended by string into test solutions for 24 hours and the static (non-functional) mercury release determined. In 1985, Brune and Evje measured dissolved amalgam mercury in natural saliva that occurred in 24 hours under static and functional conditions, using three daily periods of cyclic loading followed by brushing. They found an average of 18.0 micrograms of intake of mercury in the presence of 20 average-sized surfaces of amalgam. (6)  

SUMMARY = UP TO 18.0 MCG/DAY BY INGESTION.  

3. In a recent in vivo experiment, designed to determine the degree of mercury vapor absorption by the oral mucosa, it was found that half of a 28-32 ng Hg exposure was absorbed. The amounts of mercury used in this experiment are frequently found in vivo after chewing.(7) Based on the data provided it is apparent that the amount of amalgam filling mercury absorbed by the oral and nasal mucosa could be substantial. However, because there was no extrapolation of the data to a daily intake amount, the information is being presented only to emphasize the point that amalgam bearers have significant intakes through absorption not previously considered. Consequently, the amount of mucosa mercury absorption will be additive to any measurements already published demonstrating amalgam filling mercury release and intake.  

4. Combined intake: To this point, only one study can be found that calculates the total intake from inhalation and ingestion together. It was done by the Occupational Safety and Health Administration in Sweden in 1987 and determined the mercury intake from dental amalgam under static conditions only,
without consideration of functional stimulation. Their conclusion was an average of 500 mcg/week (71.5 mcg/day). (8)

**SUMMARY OF COMPARATIVE INTAKE:** (According to published research!)

- Dietary methyl mercury = 2.0-10.0 micrograms/day.
- Inhaled amalgam mercury = 2.5-17.5 micrograms/day.
- Ingested amalgam mercury = Up to 18.0 micrograms/day.
- Combined amalgam mercury = Up to 71.5 micrograms/day.

**USEPA MERCURY INTAKE STANDARD:** For the 70 kg (154 lb) adult. (1)

- Mercury from all sources = 30.0 micrograms/day.
- Non-dietary mercury = 20.0 micrograms/day.

At this point it may be readily seen that, according to the documented research, mercury intake from dental amalgam fillings is certainly not insignificant compared to dietary mercury intake. Indeed, it is becoming increasingly apparent that mercury intake from dental amalgams far exceeds dietary mercury intake. Moreover, it is also apparent that in many individuals the intake of mercury from dental amalgams may exceed the Mercury Intake Standard established by the U.S. Environmental Protection Agency.

It is also important that the mercury release from amalgam be discussed in terms of the effect on the filling itself. If these studies are accurate, will such a release of mercury result in rapid breakdown of amalgam fillings intra-orally, a situation that certainly is not experienced clinically? According to the textbook on dental materials by Craig and associates, one **AVERAGE** sized dental amalgam contains 780 milligrams of mercury. (10) As there are 1000 micrograms in each milligram, a loss of 20 mcg/day (the USEPA standard for adult maximum intake of all non-dietary mercury) would equal 7.3 milligrams/year (7300 micrograms), which is less than 1% of the mercury contained in **ONE AVERAGE SIZED DENTAL AMALGAM FILLING**! Obviously, the potential for harm exists without experiencing mass visible breakdown of amalgam fillings.

**COMPARATIVE TOXICITY**

In 1969, an international committee of expert toxicologists released their report of a symposium held at the Karolinska Institute in Stockholm, Sweden. (11) They classified the forms of mercury according to relative toxicity, stating that methyl and ethyl mercury salts were the most toxic followed by mercury vapor and finally inorganic and other organic mercury salts. The committee stated, interestingly, "When numerical values for MAC (Maximum Allowable Concentrations) values are considered, it is obvious that there exist little epidemiological data which provide scientifically satisfactory information about detailed dose-response relationships in man, even for a single mercury compound. The group has accepted the philosophy of an informed estimate provided enforcement of the proposed MAC values is combined with medical supervision of the workers exposed".

As stated in this quote, it is quite clear that the expert committee was providing an "estimate" based on uncertain data. Nonetheless, opinions of the relative toxicity of mercury vapor compared to methylmercury are based on this document, without regard to the information contained in the Committee’s report. For example, the Committee stated "Although it has been shown that absorption from the intestinal tract of solutions of methyl mercury compounds is almost complete, this is not necessarily valid for methyl mercury compounds found in fish. There are some indications that intestinal absorption in that case is less complete, though the difference has not been completely defined".

What are these indications that distinguish methyl mercury derived from fish from methyl mercury from other sources, and what are these 'other sources'? The most notable, and the most thoroughly studied outbreaks of methyl mercury poisoning occurred in Minimata and Niigata, Japan and in Iraq. The former
outbreaks were from fish-derived methyl mercury and the latter from methyl mercury derived from fungicide-treated grain, intended for planting but actually made into bread and consumed by locals.

In Iraq, the exposure period was 2-3 months in late 1971 and early 1972 with nearly 500 reported hospital deaths. In Japan, the Minamata outbreak occurred between 1953 and 1960 with 46 recorded deaths and the Niigata outbreak occurred in 1960 with 6 recorded deaths by 1970.(12,13)

There is an obvious dramatic difference in the severity of the poisonous outbreaks in the two locales, particularly in relation to the length of time of the exposures. Two obvious explanations for the disparity would be the amount of exposure (dose) and the numbers of people exposed. However, data derived by several investigative groups found that the incurred doses in the two locales were equivalent.(12,13) Moreover, demographic data clearly shows that a great many more people were exposed in Japan than in rural Iraq.(12,14)

Further evidence of low toxicity of fish-derived methyl mercury is found in studies in Sweden and Finland (11,12,13), in Canadian Indians(2,13), Peru(13) and in fisherman in Korea and American Samoa (12,14). No cases of methyl mercury poisoning were found in the groups in Sweden, Finland, Canada, Peru, Korea, and American Samoa even though the exposure doses were found to be at least equivalent to the Iraqi epidemic. On the other hand, there have been reported cases of poisoning due to industrial exposure to methyl and ethyl mercury.(11)

Duration of exposure is another factor to be considered, since the exposure doses in Iraq were of a much shorter duration. However, the elimination half-time of methyl mercury is 70 days and since Japanese fish eaters were ingesting methyl mercury on a virtual daily basis for years, regarding their cumulative body burden to be less than the Iraqi victims is scientifically illogical.

The actual form of the ingested methyl mercury is another factor to consider when investigating the apparent low toxicity of fish-derived methyl mercury. It has been well established that the toxic effects of mercury at the cellular level occur when the mercury atom disassociates from its transport vehicle and attaches to body tissue ligands, thereby altering the latter’s function.(2,11,15) The toxicity of the various forms of mercury is determined by the absorption rate of each form, which is extremely variable.

It has been widely assumed that methyl mercury is lipid (fat) soluble, which accounts for its ability to transport across cell membranes and therefore its rapid and complete intestinal absorption. However, Clarkson and associates recently stated "Lipid solubility is not a property of all organometal compounds. For example, dimethylmercury is lipid-soluble, whereas monomethyl mercury is a water-soluble cation. It does form a limited number of lipid-soluble compounds (e.g. methylmercury halides), but methylmercury complexes with proteins and amino acids are water- soluble, not lipid-soluble. The latter are probably the predominant forms of methylmercury in living organisms".(16)

In an even more recent publication, Clarkson and Friberg and associates stated "The solubility of methylmercury chloride and other halide salts in non-polar solvents has sometimes been interpreted to indicate that ‘methylmercury’ is lipid soluble. The ‘lipid solubility’ of methylmercury has been invoked to explain its rapid transport across cell membranes and to predict that MeHg will be sequestered in lipid and fat depots in the body. In fact, the methylmercury cation (CH3Hg+) is highly water soluble, and binds preferentially to sulhydryl groups in proteins, peptides and amino-acids to form water soluble complexes. Analysis of tissues of animals exposed to MeHg indicate binding to the protein but not the lipid fraction (Yoshino et al., 1966)". (2)

Very limited data is available about the actual compounds of methyl mercury found in fish, and what the absorption rate of each form actually is. The National Academy of Sciences has stated that approximately 95% of the methyl mercury bound to fish protein is part of the methylmercury-cysteinyl coordination complex.(13) One must wonder if the absorption rate of these forms in human GI systems is significantly
different than that of methyl mercury combined with chlorine or other halides. It is known, however, that the various inorganic mercury compounds exhibit a wide range of absorption rates. It is of interest to speculate that the various organic compounds of mercury might exhibit the same characteristic as do mercury's inorganic compounds, and that this might influence their relative toxicity.

There is one more facet of water-vs. lipid-solubility that should not be overlooked; that of ability to penetrate the blood brain barrier (and probably the placental membrane as well). The autopsy study of Nylander and Friberg and associates performed in Sweden measured levels of inorganic and methyl mercury in the brains of subjects with and without dental amalgam fillings. (9) Total mercury levels correlated with the number and surfaces of amalgam fillings present. However, the levels of methyl mercury found were low in both groups; and although the authors postulated that there may be demethylation to inorganic mercury occurring, the observed correlations were reflected only in elevated levels of inorganic mercury in the amalgam bears. It is interesting to note that the scientists specified 'low levels' in reference to methyl mercury. Although no data was available on fish consumption in the subjects, it is well established that such consumption in Sweden is relatively high, at least compared to fish consumption in the U.S.A. One wonders if the methyl mercury derived from fish was primarily in water-soluble form, thereby limiting its penetration of the blood brain barrier, if not intestinal absorption itself. This would certainly influence the toxic effects of the methyl mercury, since its target organ is well defined to be the central nervous system.

**SELENIUM IN FISH**

There is one final, but vital, factor to consider when evaluating the toxic effects of fish-derived methyl mercury. This factor is well documented and described in the scientific literature. However, it has somehow escaped the attention of dental amalgam advocates publicly claiming that mercury vapor exposure to patient bearers of amalgam fillings is far less toxic than the methyl mercury derived from eating fish. The omission is so glaring as to cast serious question on the knowledge and credibility of those publicly defending the continued use of dental amalgam.

It has been scientifically established that fish with high levels of methyl mercury also contained even higher levels of selenium. This scientific fact was pointed out by none other than the prestigious National Academy of Sciences (NAS) in their 1978 document "An Assessment of Mercury in the Environment".(13) The National Academy of Sciences also pointed out the protective effects of selenium against mercury toxicity and stated "The most consistent beneficial influence of selenium has been reduction of the lethal and neurotoxic effects of methylmercury compounds". The NAS reviewed 23 studies establishing and verifying the protective effect of selenium against mercury toxicity. For example, one study demonstrated that animals fed mercury in their diet were intoxicated at 4 weeks and had a 52% mortality after 4 to 6 weeks. However, the other group of animals who were fed the same concentration of mercury in a diet containing 17% tuna were free of symptoms of intoxication for a longer time and only 7% died. The NAS stated "Tuna contain enough selenium (normally up to 20 mcg/g) to reduce the toxic level of methylmercury". (13)

The NAS also stated "in studies of chronic dietary exposure to methylmercury and selenite, control rats died with symptoms of neurotoxicity and concentrations of methylmercury in the brain well below those in rats protected by selenite".

In discussing the protective mechanism of selenium against mercury toxicity the NAS revealed that "Selenium forms the active site of the enzyme glutathione peroxidase and readily replaces sulfur in the sulfur-containing amino acids" and "the selenohydryl group binds methylmercury 100 times more tightly than the sulfhydryl group". (13)
Finally, the NAS concluded "Recent studies of human populations that consume large quantities of tuna have revealed no definitive sign of mercury poisoning, although some individuals had elevated mercury levels in blood and hair" and "Methylmercury in tuna, swordfish, and other large ocean fish appears to be less toxic than methylmercury ingested under other circumstances". (13)

SUMMARY

According to valid documented scientific research, it is clear that PATIENT MERCURY EXPOSURE FROM DENTAL AMALGAM FILLINGS, IN TERMS OF BOTH DAILY INTAKE AND COMPARATIVE TOXICITY, IS NOT TRIVIAL OR INSIGNIFICANT COMPARED TO METHYL MERCURY EXPOSURE FROM FISH!!! To argue or challenge this documentation, amalgam defenders must provide counter-documentation refuting these referenced scientists, toxicologists, and such esteemed groups as the National Academy of Sciences, the U.S. Environmental Protection Agency, and the International MAC Committee.

Those individuals claiming to be authorities on dental amalgam mercury, the very same individuals who are responsible for formulating the dental profession's position on the use of dental amalgam and thereby influencing the public health, cannot negate this information by attempting to challenge the credibility of Bio-Probe. We have done nothing more than reveal documented scientific facts.

Bio-Probe has done what few others have even attempted. We have devoted the last five years to gathering, compiling and coordinating existing scientific documentation on mercury. On the other hand, articles defending the use of dental mercury amalgam are nothing more than opinion papers that have selectively excluded, either through ignorance or malice of forethought, key research that totally destroys their position.

A prime example of this presentation of misinformation is the article that appeared in the ADA News on 1 December 1986 entitled "Mercury-from fish to fillings: Vapor from amalgam 'extremely minute'". (17) The article was by ADA employees Enid A. Neidle, PhD, P.L. Fan, PhD, and Dan C. Langan, DDS. Dr. Fan stated "Fish and other seafood have been shown to contain methyl mercury (also referred to as organic mercury), a much more toxic form of mercury than the elemental mercury used in dental amalgam. Methyl mercury is more toxic because of its ability to cross cell membranes and its greater retention in the body". Is Dr. Fan really unaware of the documentation presented by Bio-Probe in this article and the research showing that mercury vapor also crosses cell membranes very readily and has a long body retention time?

Dr. Langan said that the elevated blood levels of mercury found in amalgam bearers was biologically insignificant without offering any documentation to substantiate that opinion. Moreover, Dr. Langan should be aware of the fact that even the National Institute of Dental Research and the ADA have publicly acknowledged that blood mercury levels do not correlate to the body burden or toxic effects of mercury. [See JADA, Vol 109. September 1984. "Workshop on the biocompatibility of metals used in dentistry." ] Therefore, what Dr. Langan calls biologically insignificant is in reality very significant in that it demonstrates unequivocally that amalgam bearers will have greater body burdens of mercury than non-amalgam bearers. Dr. Neidle stated "Using this information [blood mercury levels resulting from fish intake] and a few simple calculations, one can determine that the potential hazard of mercury exposure from amalgam is insignificant compared to mercury exposure from fish." Setting aside Dr Niedels' distortion of the facts, if two people eat the same amount of mercury-laden fish, one an amalgam bearer and one without amalgams, who will be at greater risk?

Never once have these ADA employees offered basic documented research demonstrating that mercury released from dental amalgam is not harming the patients. They continue to present misinformation to the profession and to the public without being required to exhibit knowledge of the subject or the basic research contained in the scientific literature. The dental profession has accepted these individuals as authorities on.
mercury. The documented research clearly demonstrates that this blind faith is misplaced. One by one, existing research is exposing their arguments for what they are, contrived statements that are contrary to scientific knowledge and potentially detrimental to the public health.

REFERENCES


ABSTRACTS/REVIEWS

SUMMARY: This experiment was designed to study the effects of mercury (HgSO4) on rabbit’s performance when added in the diet. Mercury was added to the normal mash diet, for seven weeks, in three different concentrations, 0, 150, and 300 ppm (parts per million). There were six rabbits in each of the respective groups. The addition of the mercury to the diets caused mortality associated with diarrhea, hemorrhage, edema and liver and stomach necrosis. The contaminated mercury diets caused significantly increased feed intake, drinking water consumption and live body gain. In the animals fed the 300 ppm mercury-diets there was a significant rise in serum glucose content with a slight decrease in serum calcium levels. There was a slight decrease in the activity of both transaminases GPT (an enzyme involved in how the body handles the amino acid alanine) and GOT (an enzyme present in the heart and liver involved in the formation of glutamic acid and oxaloacetic acid). The most affected organ in the animals on the 300 ppm Hg-diet was the liver, which showed a severe reduction in its vitamin A content and a significant reduction in iron content. The high Hg-diet also caused an increase in bone magnesium content.

BIO-PROBE COMMENT: The increased consumption of water and the increased serum glucose levels are classic diagnostic symptoms in the onset of diabetes. The decrease in liver vitamin A and iron certainly bears additional investigation because of the current studies being carried out on the roles of vitamin A and iron deficiencies or dysfunction in the development of cancer. We were aware that mercury inhibited some magnesium controlled enzymes in the body but to our knowledge this represents the first indication of effect on bone mineral content. This particular field of investigation could be exciting because of the documented effects of mercury on calcium metabolism and the continued escalating incidence of osteoporosis. Although the levels administered to the rabbits were extremely high in relation to the dietary limitations of humans it demonstrates the tremendous toxic potential of mercury. More importantly, it places added urgency on the need to place in perspective the increase to mercury body burden possible from the constant inhalation and ingestion of mercury from amalgam dental fillings and why the existing criteria documents establishing limitations on the exposures of humans must take into consideration its significant additive effect to that of dietary and environmental exposures.

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ABSTRACT: The purpose of this study was to compare the relative cytotoxicity of amalgams and to determine whether their toxicity depends upon composition and aging time, by means of a rapid and sensitive in vitro cell culture test. Zinc-containing amalgams showed higher cytotoxicity than did any other amalgams. High-copper amalgams had the same cytotoxicity as did the low-copper amalgam. The addition of selenium did not reduce the cytotoxicity of amalgam. Moreover, excessive additions of selenium increased the cytotoxicity of amalgam compared with that of a similar selenium-free material. The cytotoxicity of amalgam was decreased with aging time, possibly due to the combined effects of surface oxidation and further amalgamation.

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ABSTRACT: The enzymatic activity of soluble protein kinase C from mice brain was inhibited by mercuric chloride (II) HgCl2 and organic mercurials, i.e. methyl mercury, phenyl mercury and p-chloromercuibenzoic acid (PCMB). (BIO-PROBE NOTE: protein kinase is an enzyme that catalyzes the transfer of a phosphate group. It is the key enzyme linking cyclic AMP to the activation of phosphorylase. The active subunit of protein kinase is designated as protein kinase C. Cyclic AMP
functions as an intracellular messenger in the action of many hormones, including adrenaline.] The IC50 was 0.08 microM for HgCl₂ and about 1 microM for organic mercurials. Sulphydryl blocking reagents such as 5,5'-dithiobis-2-nitrobenzoic acid (DTNB) and N-ethylmaleimide (NEM) were close to unity whereas the values for organic mercurials were 1.3 to 1.5. [BIO-PROBE NOTE: A reagent is a chemical substance that is known to react in a specific way. In this instance, blocking sulphydryls. These results were then compared to those obtained using the mercury.] The inhibition was of a non-competitive type with respect to H1 histone. 3H-PDBu binding activity was also inhibited by all of the reagents in a non-competitive manner. Mercurials apparently bind to sulphydryl groups of protein kinase C to inhibit the enzymatic activity.

BIO-PROBE COMMENT: Histones are simple proteins that are soluble in water and are found in the cell nucleus, especially in glandular tissue such as the lymph, spleen and thymus. Histones complex with nucleic acid to form nucleoproteins. The globin of hemoglobin is a histone. Some histones can also interfere with coagulation of the blood and have been isolated from the urine of patients with leukemia and febrile conditions. It would appear from the data presented that the inhibitory effect of both inorganic and organic mercury on the enzymatic functions of protein kinase C could have a devastating effect on many critical functions of the human body. Does this place the person with a mouth full of mercury amalgam dental fillings, chronically inhaling mercury vapor, at greater risk of eventually succumbing to disease states that their body normally would have rejected and sloughed-off?

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SUMMARY: Several aspects of Hg release from dental amalgam tooth fillings were examined both in vivo and in vitro. By light microscopy, Hg globules (diameter = 1-2 μm) were observed on amalgam surfaces.

Hg vapor was measured in exhaled air before and after 5 minutes of gum chewing in 3 groups of subjects with varying numbers of dental amalgams (Group 1: having symptoms similar to chronic low-dose Hg exposure, N = 22; Group 2: having no apparent symptoms and considered healthy, N = 20; Group 3: controls having no amalgam fillings; N = 10). Groups 1 and 2 both demonstrated a significant 3-fold increase in Hg vapor levels after chewing, while levels in controls remained undetectable. A mouth rinse with hot water (55°C) in Group 2 resulted in a further increase in Hg vapor levels. Saliva samples (1 ml) from 17 subjects in Group 2, collected before and after chewing, showed a significant 8-fold increase in Hg concentration after chewing. In a fourth group Hg absorption by the oral mucosa was studied, Group 4, N = 10. A notably high absorption was found after 3 minutes.

Dr. Fredin concludes his article with the following paragraph: "The conclusions of this investigation are that dental silver amalgam is an unstable alloy and an unacceptable source of mercury, which might constitute a threat to health. In the continuous efforts to minimize environmental and industrial mercury exposure, a decrease in the use of silver amalgam in dentistry - a toxicologically unsuitable dental filling material (Socialstyrelsen 1987) - must be considered an important contributory measure. It is concluded that dental amalgam should be considered an unstable alloy constituting a long-term Hg exposure and toxicologically unsuitable as a dental filling material."

Correspondence to Dr. B. Fredin, Box 146, S-22100 Lund, Sweden.

BIO-PROBE COMMENT: The Socialstyrelsen is the Swedish Health Board and the 1987 reference refers to the findings of an expert commission appointed by the Socialstyrelsen to investigate the potential toxicity of amalgam.

ABSTRACT: Excretion and organ distribution of mercury and susceptibility to methylmercury (MeHg) toxicity were compared between strains and sexes after successive oral administration of MeHg Chloride (15 mg/kg per day) using BALB/cA (C) and C57B/6N (B6) mice. Every mouse died several days after initiation of toxic symptoms, and significant strain and sex differences were found with regard to length of survival. C mice of both sexes died earlier than B6 mice. B6 males survived much longer (greater than 6 weeks) than B6 females (3 weeks), whereas C males died earlier than C females. B6 male mice showed remarkably higher urinary Hg excretion and lower Hg levels in the brain, liver, kidney and blood than the other 3 groups. With daily MeHg administration, the Hg levels in all tissues except the kidney showed linear increase until the manifestation of toxic symptoms. Mercury accumulation in the kidney, the tissue with the greatest uptake of Hg in the mice examined herein, was biphasic: accumulation was rapid for 7-10 days after which the rate of increase was greatly reduced until death. It is suggested that conditions resulting in saturation of the rate of kidney Hg uptake might cause inhibition of urinary Hg excretion via some disturbance of renal function. Subsequently, Hg accumulation would be accelerated in various tissues, including the brain, leading to manifestation of toxic symptoms.

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REVIEW: Previously published data had indicated that mercury caused lipid peroxidation affecting cell membrane function supporting the free radical theory of mercury toxicity. Ichikawa and his colleagues set out to specifically test cells and tissues for the formation of lipid peroxides and the free radical theory of oxidative cell membrane damage by mercury. Both inorganic and methylmercury were used.

The data from this study showed that lipid peroxidation was not the cause of hemolysis of human erythrocytes exposed to inorganic or methylmercury. Both forms of mercury acted as hemolytic agents causing leakage of hemoglobin. Concentrations of methylmercury in excess of 4 ppm induced rapid hemolysis. Below the 4 ppm level, initiation of hemolysis was slower with induction producible by as little as 0.4 ppm. Human erythrocytes exposed to various concentrations of inorganic mercury gave qualitatively similar results, but were 10 times more potent in causing hemolysis.

Another significant finding of this study was that vitamin E, even at erythrocyte membrane levels increased by 70%, did not alter the time required for 50% mercury induced hemolysis to occur.

The authors stated "The results of this study are not in conflict with the Ganther hypothesis. They simply show that conditions necessary to cause formation of free radicals from methylmercury are absent in erythrocytes and that damage to their membranes noes not require oxygen, free radicals, or lipid peroxides. This leaves the question of the mechanism of mercury-induced hemolysis open. The most likely reactions initiating the hemolytic process are between mercury and protein sulphhydryl groups. Some evidence for this exists already."

[Bio-Probe Note: The Ganther hypothesis proposed that organomercury compounds can be converted in vivo to free radicals, which in turn cause damage to target molecules by alklylation or hydrogen abstraction.] Correspondence to Janusz M. Gebicki, School of Biological Sciences, Macquarie University, N.S.W., 2109, Australia.


ABSTRACT: This study assesses the early cavomarginal breakdown of the newer posterior composite resin restorations compared with that of amalgam restorations. A total of 432 posterior composite restorations and 73 amalgam restorations were examined: 121 composite restorations (28%) and 44 amalgam restorations (60%) clinically showed a marginal crevice at some point on the cavosurface margin
of the restoration at 6-month, 1-year-, and 2-year recalls. The largest single reason for poor marginal adaptation was marginal fracture. Up to 2 years, the marginal integrity of the studied posterior composites was superior to that of an amalgam alloy. It was determined that smaller cavities, greater bulk of resin at the margin (especially at functional cusp areas), and well-finished margins without overfilling seem to reduce the occurrence of marginal fracture on composite resin restorations.

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REVIEW: The results of this study demonstrated that the addition of Hg^{2+} to mitochondria of rat kidney induces efflux of intramitochondrial Ca^{2+}.

There are a number of published studies showing that sulfhydryl groups of membrane proteins are involved in the control of mitochondrial Ca^{2+} transport. As there are many theories as to how sulfhydryl control of transport is effected, Chavez and Holguin set up a series of experiments designed to clarify the control mechanism. Hg^{2+} was used as the reagent because of its known affinity for sulfhydryl groups and at a concentration of 5 and 6 μM produced a marked acceleration of Ca^{2+} release. Cysteine (200 μM) failed to induce the reuptake of Ca^{2+} as released by 5 μM Hg^{2+}; however, 12.5 μM cysteine added before Hg^{2+} completely abolished the Hg^{2+}-induced Ca^{2+} efflux. The authors' felt that the lack of effect of cysteine to reverse the effects of Hg^{2+} suggested that the binding of the mercuric ion to the membrane thiol groups involved in the Ca^{2+} efflux was irreversible. However, the addition of 50 μM of EDTA caused a rapid and almost complete restoration of membrane potential. The effect of EDTA was not due to chelation of Hg^{2+}, since the amount of Hg^{2+} bound to mitochondria was not modified by EDTA.

Previous studies had demonstrated that dithiothreitol (DTT) prevented mitochondrial damage and the accompanying Ca^{2+} release. [Dithiothreitol (DTT) is a protective agent for SH groups.] In analyzing the effect of DTT on Ca^{2+} efflux induced by Hg^{2+} it was determined that in the presence of DTT, the binding of approximately 1 nmol of Hg^{2+}/mg of protein suffices to induce the release of the accumulated Ca^{2+}.

Ca^{2+} efflux caused by Hg^{2+} was accompanied by a decrease in the NAD(P)H/NAD(P) ratio and by a collapse in membrane potential. [nicotinamide adenine dinucleotide (NAD)/phosphate NAD(P)and the reduced form is NADH.] Findings in previous studies have indicated that there are NAD-binding proteins involved in Ca^{2+} transport.

[BIO-PROBE COMMENT: This is one more study confirming that mercury affects the metabolism of calcium in the body. The mere fact that mercury has the potential to modify calcium homeostasis should be of major concern for anyone experiencing heart, muscle or bone problems.

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FORUM

Of late, Bio-Probe has been getting several queries related to the composition of endodontic filling material. With most of them asking if gutta-percha contained mercury. Like many other dental materials, manufacturers of gutta-percha do not indicate the composition of their products. According to Spangberg in the text Biocompatibility of Dental Materials, Vol III, page 187, CRC Press Inc. Boca Raton Fl, 1982, various analyses have indicated that gutta-percha composition varies between brands:

<table>
<thead>
<tr>
<th>Material</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gutta-percha</td>
<td>19-22%</td>
</tr>
<tr>
<td>Zinc-oxide</td>
<td>59-75%</td>
</tr>
<tr>
<td>Heavy metal salts</td>
<td>1-17%</td>
</tr>
<tr>
<td>Wax or resin</td>
<td>1-4%</td>
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Based on the above, only one-fifth of the endodontic cone consists of the polymer gutta-percha and depending on the manufacturer and heavy metal content, the cone could contain mercury.

It is an area of concern that Bio-Probe will investigate further and report on in a future issue.

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The combined American Holistic Medical Association and Holistic Dental Association 1989 Annual Meeting will be held March 6-12, 1989 at the Seattle Airport Hilton Hotel. This is a comprehensive program. If you have not received a program outline and attendance application, write to the Holistic Dental Association, Inc., 974 North 21st St., Newark, OH 43055. This will be the first time that the members of the American Holistic Medical Association have heard presentations on the mercury amalgam issue. Presentations will be made by Sandra Denton, M.D. and Michael F. Ziff, D.D.S. Dr. Ziff is considered one of the world’s foremost authorities on the scientific literature related to mercury and the amalgam controversy. Dr. Sandra Denton has recently left the Tahoma Clinic in Kent, Washington and is now associated with Dr. Rowen at the Omni Medical Center in Anchorage, Alaska. Dr. Denton has had a wealth of clinical experience working with the mercury toxic patient and will be sharing some of this information with those in attendance.

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The American Academy of Biological Dentistry will be presenting a seminar entitled the Scientific Basis of Herbal Therapy in Dentistry and Medicine. The presenters will be Edward K. Alstat, N.D., R.Ph. and Daniel B. Mowrey, Ph.D. The dates are March 11 and 12, 1989 at Carmel Mission Inn, Carmel, California. For further information write to the American Academy of Biological Dentistry, P.O. Box 856, Carmel Valley, CA 93924 or call at 408-659-5385.

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The Foundation For Toxic Free Dentistry (FTFD) is embarked on a special effort to raise money to help fund research on amalgam mercury. (All contributions are tax-free.) The research is being done at the University of Calgary Medical School by a team of distinguished scientists. Preliminary results from a small study indicate that it is imperative the larger study with more animals be completed. For whatever the reasons, the Canadian Government has not seen fit to provide the requested grants to fund the study. This research project has the potential to produce data that will resolve the controversy over the safety of dental amalgam. If you have ever wanted to participate in a research project that has the potential of producing results that will benefit mankind all over the world, here is your opportunity. The Foundation will provide the names of all contributors (who do not wish to remain anonymous) when it forwards the check to the University of Calgary. Won’t you be a part of this exciting research effort? Send your tax-deductible check today. Checks should be made out to FTFD and mailed to P.O. Box 580160, Orlando, FL 32858-0160.

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