Biologic Effects of Lead in Domestic Animals

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ABSTRACT

Lead poisoning in cattle usually is the result of a single ingestion of a material containing a large quantity of lead. Poisoning in cattle also can result from the long-term ingestion of crops or pasture forage contaminated by lead settling out from fumes and dusts emitted from industrial lead operations. The latter is the principal source of poisoning for horses. Horses appear to be more susceptible than cattle to the long-term ingestion of lead. Whereas a daily intake of approximately 2 mg/kg can produce poisoning in horses, a daily intake of approximately 6-7 mk/kg is required to produce poisoning in cattle. Although the ingestion of small amounts of lead by food-producing animals may not result in clinical signs of lead poisoning, it should be emphasized that a small fraction of that ingested will be retained in the tissues and contribute to the dietary intake of man.

It generally is considered that lead is the most common cause of accidental poisoning in domestic animals. The condition is diagnosed most frequently in cattle and dogs. It should be kept in mind that a discussion of lead poisoning in domestic animals must differ from the approach taken for man. Whereas subtle, subclinical effects of lead are highly relevant and important for man, similar considerations in animals are not practical. Lead poisoning in animals usually is recognized only when overt clinical signs of poisoning are apparent. Nevertheless, it is emphasized that even though apparently non-toxic quantities of lead are ingested by food producing animals, some of the lead will be absorbed. This would result in the addition of a finite amount of lead to the dietary intake of man.

Sources of Lead

The natural curiosity and licking habits of cattle make any available lead-containing material a potential source of poisoning. Some of the sources incriminated include lead-base paint (either from discarded paint cans or paint peeling from walls), used motor oil, discarded oil filters, storage batteries, certain types of greases and putty, and linoleum (Hammond et al., 1956; Buck, 1970a). These sources have been incriminated on the basis of 1) evidence of ingestion, 2) clinical signs, and 3) finding elevated concentrations of lead in the tissues. These sources can be found in the vicinity of farm buildings and in dumps located in pastures. It is interesting that these sources rarely are incriminated in lead poisoning in horses. Horses are much more selective than cattle in their eating habits. They usually do not lick old paint cans, storage batteries, peeling paint, nor do they seem to find the taste of used motor oil attractive.

Common histories of exposure in dogs include chewing on objects painted with lead-base paints, (e.g., when home remodelling entails scraping of plaster and old paint), eating linoleum, or ingesting lead materials such as shotgun slugs or curtain weights (Zook et al., 1969). The latter objects are retained in the stomach where they are ionized to an absorbable form due to the

[1]For personal data, see footnote 1 to Dr. Aronson's paper entitled "Biologic Effects of Lead in Fish," this issue.–Ed.

Wenatchee orchard workers with respect to fertility can also be applied to the problem of whether men or women are more susceptible to lead. They say, "The instances reported in the literature of an effect of lead on human fertility appear to be limited to men and women who were far more heavily and much more regularly exposed to lead than the residents of Wenatchee." It would appear that a clinical state approaching that of frank lead poisoning is necessary before the fertility of men and women is affected. I would add that similar conditions seem to have to prevail to demonstrate a difference in reaction between men and women to a given amount of lead. While it is true that children may exhibit more alarming symptoms and face a more grave prognosis when suffering from lead poisoning, it is also true that the dose of lead which the child ingested was usually many fold greater in proportion to his size than that received by most adults suffering from lead poisoning. The mean daily fecal output of lead by the lead-poisoned children in Chisolm's series (44 mg Pb/day) exceeded by approximately 6-fold that of a group of severly exposed industrial workers (7.6 mg Pb/day). There are many other facets of the problem of special sensitivity which can quite properly be raised such as: Are persons with special diseases or the elderly more sensitive to lead? And the answer at this time has to be that in the thousands of years of man's experience with lead, such groups have not been uncovered, but it is possible that with more refined diagnostic tools such groups may be found in the future. This is not the same as saying that because we don't know for certain that such groups do not exist that there is a high probability that they will in fact be found.

I have attempted to deal with the problem of safe levels in a manner that raises issues common to many chemicals in our environment. For instance, in a review article on "Mechanisms of Oxygen Toxicity," by Niels Haugaard, his opening words are "Except for organisms especially adapted to live under anaerobic conditions, all animals and plants need oxygen for the production of energy and maintenance of life. Yet oxygen is toxic to life at concentrations only slightly greater than that found in air." In fact it would be just as difficult to answer the question, "Is there a safe level of oxygen?" as it is to answer the question, "Is there a safe level of exposure to lead?" If we are to set a safe level of lead exposure based on biochemical changes we cannot interpret, we are setting in train a series of events which have their impact not only on economics, social patterns, and our natural resources, but also on biological systems.

We are, as members of society, often counselled to make no moves affecting our health and welfare, the consequences of which are not completely understood and yet we find these same councellors often surprisingly willing to advocate crash programs to remedy some real or imaginary threat. All agents in the environment that can under certain conditions cause harmful effects are not equally hazardous, and I firmly believe that a sensible plan of attacking the most important items first can be drawn up, provided the facts are allowed to speak for themselves. I believe that lead poisoning in children constitutes a definable problem of considerable seriousness about which something useful can be done. Since our resources are finite, I would put this item far ahead of the threat to health from other sources of lead in the environment.