

Heavy Metals in Vaccines

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Abbreviations

AEs Adverse events

Abstract

Vaccinations have helped immensely to diminish the impact and spread of disease; however, the benefits are not free from risks. Possible adverse events (AEs), including an increased probability of autoimmune reactions, should be considered by both the veterinarian and the client prior to administering inoculations. In this review of the literature, the addition of heavy metals such as aluminum and mercury in adjuvants in killed and inactivated vaccines is scrutinized. These heavy metals are added to boost antigen-specific immune responses in order to make the vaccines work more quickly or effectively, yet it has been documented that they can cross the blood-brain barrier and remain there indefinitely. In addition to vaccine delivery of heavy metals into the body, dietary ingestion can lead to accumulation of heavy metals in the body. Ultra-trace minerals, including chromium, nickel, molybdenum, silica, and aluminum, are not regulated by the National Research Council (NRC) or the American Association of Feed Control Officials (AAFCO), and there are currently no set safe upper limits. While most of these minerals play a role in metabolism and have dietary requirements, aluminum is toxic and has no known nutritional role. Long-term exposure to these minerals can lead to liver damage, gastrointestinal inflammation, and brain toxicity. The potential for AEs following exposure to heavy metals in vaccinations merits further investigation.

Adjuvants and Adverse Events

Millions of vaccines are routinely given to humans and animal species throughout the world, with relatively

few documented adverse events (AEs) (1–3). Vaccine-related side effects do occur, however, which raises significant scientific and clinical concerns (3–5). Possible AEs include fever, arthritis, uveitis, soreness, lethargy, and an increased probability of autoimmune reactions (5). Many of these concerns relate to the adjuvants added to killed, inactivated vaccines to accelerate, prolong, or enhance their antigen-specific immune responses (4–6). Although these inactivated vaccines containing adjuvants make up approximately 15% of the veterinary biologicals used, they have been associated with 85% of the post-vaccination reactions (1–9). Thus, adding adjuvants to vaccines to enhance their immunogenicity increases the risk of autoimmune and inflammatory AEs. These reactions are known as the autoimmune/inflammatory syndrome induced by adjuvants (ASIA), first coined by Stejskal and others to reflect the effects of the addition of heavy metals in vaccines (9, 10).

Despite the fact that adjuvants have been used safely in human and veterinary medicine for decades, heavy metal exposures from vaccines is an emerging concern for the health of humans, pets, and livestock (6–15). Particular attention is focused on the safety of using the heavy metal salts of thimerosal (mercury) and aluminum in vaccines (10–15). Although trivalent aluminum occurs naturally in the environment and is ingested with food and water consumption, this form of aluminum is absorbed at a rate of 0.25% into intestinal circulation, versus the divalent form of aluminum in adjuvanted vaccines that can be absorbed up to 100% effectively into circulation (16, 17). Ingested trivalent aluminum is transformed into

aluminum hydroxide and excreted through the kidneys, yet divalent aluminum, found in adjuvanted vaccines and injected intramuscularly, can bind to transferrin, enter cerebrospinal fluid, cross the blood–brain barrier, and be deposited and stored in the brain indefinitely (16, 17).

Recently, a British study found levels of aluminum to be consistently high in the brain tissue of donors previously diagnosed with autism (16, 17). Aluminum was found intracellularly in microglia-like cells and other inflammatory non-neuronal cells throughout the brain tissue (17). The specimens, including a sample from a 15-year-old boy, exhibited some of the highest levels of aluminum recorded to date and offer insight into some of the possible environmental factors leading to the development of autism (17). Because adjuvanted vaccines have been implicated in accumulation of aluminum in the brain, looking into heavy metal–free alternatives seems practical (11–17).

Adjuvants and Vaccine-Induced Sarcomas in Cats

Vaccine-induced sarcomas in cats, although uncommon, have most often been found to be associated with the feline rabies and leukemia virus vaccines (18, 19). It is thought that inflammation caused by these adjuvanted vaccines encourages neoplastic transformation, although the exact mechanism remains unclear (18, 19). The occurrence has been found to be between 1 to 10 out of 10,000 cats, and although locally invasive, metastasis has been found to be 10% to 28% (18, 19). To minimize risk of tumor development, vaccines should be given as often as necessary but as infrequently as possible, and non-adjuvanted, modified live, or recombinant vaccines should be chosen in place of adjuvanted vaccines when available (20). Furthermore, vaccines should be given as distally on the limb as possible or in areas to allow for future surgery, as radical, complete incision is required to prevent tumor recurrence. For the best prognosis, radiotherapy or immunotherapy is recommended following surgical excision (20).

Aluminum Adjuvants in Sheep

Vaccines containing aluminum are commonly used in sheep herd management and have been shown to cause ASIA (13). Studies from Spain evaluated sheep divided into 3 groups: control, aluminum adjuvant only, and aluminum-adjuvanted vaccine. A total of 16 inoculations were given to the groups over an 11-month period. Results showed behavioral changes, aggression, stereotypic and excitatory responses, compulsive eating, and reduced sociability in both the adjuvant-only and adjuvanted vaccine groups but not in the controls. These changes were more pronounced in the vaccinated group, and some began after only 7 inoculations (13).

Body Weight and Vaccine Volume

In veterinary medicine, published evidence with a bivalent canine distemper and parvovirus vaccine given as a half-dose to 13 adult dogs of small breeds documented that it conveyed full protective immunity, as determined by serum antibody titers run before and at 2 time points after vaccination (21). Thus, with owner informed consent, the size of the animal being vaccinated could be taken into account, with the exception of the legally mandated rabies vaccine where dose reduction is not permitted (1, 2). This approach would not only give the vaccinees less vaccinal antigen(s) but also would reduce the amount of vaccine excipients, such as heavy metals, fetal calf serum, egg protein, tissue culture remnants, and other proprietary components (1).

In contrast to animal vaccine use and the potential volume reduction for smaller pets, body weight is ignored with respect to human vaccines, as the heavy metals are included to enhance immune efficacy (14, 15). Most disturbing is the fact that neonates currently receive 17 times more aluminum from vaccines than would be allowed if the doses were adjusted for body weight. Some experts now urge that aluminum and mercury not be given in vaccines until after brain maturation (no earlier than 6–7 months of age but preferably not before 12 months) (14, 15, 17). Suitable alternatives to these heavy metals are calcium phosphate and zinc (14, 16, 17, 22).

Heavy Metal Exposures

The information summarized above reveals the current need to provide more effective education about the benefits and potential risks associated with vaccine use in humans and animals (1, 3).

The aluminum adjuvants added to vaccines elicit a more robust immune response that is intended to increase vaccine efficacy (14). However, infants and young children throughout the world receive a series of multiple inoculations that include high quantities of mercury and now aluminum. Incremental changes to the recommended vaccination schedule, along with the introduction of new aluminum-containing vaccines for pneumococcus and influenza, have significantly increased the quantity of metals in childhood immunizations despite the federal U.S. phase-out of the use of mercury-based vaccine adjuvants between 2000 and 2002 (14). This government policy change has seemingly overlooked the evidence that injected aluminum can be detrimental to health. Aluminum is capable of remaining in cells long after vaccination and may cause neurologic and autoimmune disorders (7, 11, 14–17). During early development, the brain of young children and animals is more susceptible to toxin

exposures, which their kidneys are less able to eliminate. Thus, these youngsters have a greater risk than adults of AEs to aluminum and other metals in vaccines (6, 7, 10, 15). Clearly, there is an urgent need to remove heavy metals, such as aluminum and mercury, from all vaccines, especially from those given to human and animal neonates and infants (7, 14–16, 21). A safer alternative, calcium phosphate, has been approved by the World Health Organization and is naturally present in the body. It was used prior to the addition of aluminum in the 1980s but is still available as an option to replace or complement aluminum as an adjuvant (16, 22). Perhaps future vaccines will utilize calcium phosphate or other, safer alternatives to aluminum or other metals.

This heavy metal accumulation is compounded in veterinary medicine by the presence of ultra-trace amounts of heavy metals in commercial dry dog foods (23). Although the major and trace mineral content of commercial pet foods is regulated by the National Research Council and the American Association of Feed Control Officials,

ultra-trace minerals (aluminum, mercury, chromium, nickel, molybdenum, and silica) are not regulated. These can be cumulative and harmful, causing liver damage, gastrointestinal inflammation, and brain toxicity (23). This recent study of 49 over-the-counter dry dog foods found aluminum in all but 3 at 38 times the average human exposure; chromium at 30-fold the average human daily intake; and molybdenum at 15 times the acceptable limit. Only silica levels in dog foods were present at acceptable human exposure limits (23).

Conclusion

Heavy metals in vaccines and foods can cause deleterious effects, ranging from mild to severe. With safer non-adjuvanted alternatives to aluminum-laden adjuvanted vaccines, as well as more judicious vaccine scheduling, hopefully fewer patients will develop AEs while still maintaining adequate levels of immunity. Increased awareness of the role of ultra-trace minerals in the diet and standardized acceptable limits can also play a role in minimizing AEs in our companion animals.

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