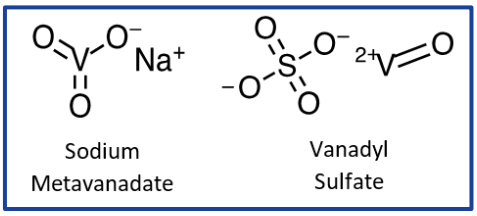
SUMMARY

Background: Vanadium is a naturally occurring metal in the earth's crust and various minerals. Human exposure to various forms of vanadium occurs primarily through ingestion via dietary sources such as food, drinking water, and dietary supplements. Sodium metavanadate and vanadyl sulfate were chosen as representative compounds of vanadium. The effects of exposure to sodium metavanadate and vanadyl sulfate in male and female rats (with exposure starting in utero) and mice (with exposure starting in adolescence) were studied to identify potential toxicity outcomes in humans.



Methods: Pregnant rats were given drinking water containing 31.3, 62.5, 125, 250, or 500 milligrams (mg) per liter (L) of sodium metavanadate or 21.0, 41.9, 83.8, 168, or 335 mg/L of vanadyl sulfate throughout gestation and while nursing their offspring. Afterwards, groups of 10 male and 10 female offspring were given drinking water containing the same concentration of sodium metavanadate or vanadyl sulfate as their mothers for 3 months. Groups of 10 adolescent male and 10 adolescent female mice were given the same concentrations of drinking water as were given to rats for 3 months. Control rats and mice received drinking water with no chemical added (0 mg/L). Body weight measurements and clinical observations were reported during the study. At the end of the study, rats and mice were assessed for alterations in blood parameters and organ weight changes, and tissues from more than 40 sites from every animal were examined for signs of disease.

Results: During nursing, rat mothers and offspring exposed to the highest concentration of sodium metavanadate displayed signs of poor health and increased mortality. Hematological effects (alterations in blood parameters), such as increased numbers of red blood cells with smaller cell volumes, were observed in both sexes following sodium metavanadate exposure in rats and mice and vanadyl sulfate in mice. Blood levels of cholesterol and globulin were decreased in rats exposed to sodium metavanadate. Male and female rats and mice exposed to sodium metavanadate and vanadyl sulfate had noncancerous abnormalities in gastrointestinal tissues, such as epithelium hyperplasia of the ileum (an increase in the number of cells lining a section of the small intestine), whereas this abnormality was not observed in the control animals. Tests evaluating the potential for sodium metavanadate and vanadyl sulfate to damage DNA were mostly negative.

Conclusions: *Under the conditions of the 3-month studies, drinking water exposure to two forms of vanadium, sodium metavanadate and vanadyl sulfate, resulted in hematological effects associated with decreased red blood cell size and increased incidences of epithelial hyperplasia of the ileum. In the sodium metavanadate studies, the lowest observed effect levels (LOELs) were 125 mg/L in male and female rats, 31.3 mg/L in male mice, and 62.5 mg/L in female mice, based on changes in hematology (in male rats and male and female mice) and epithelium hyperplasia in two regions of the small intestine, the ileum and the jejunum (in male and female rats). In the vanadyl sulfate studies, the LOELs were 168 mg/L in male and female rats and 83.8 mg/L in male and female mice, based on epithelium hyperplasia in the ileum (in male and female rats and mice) and hematology (in female mice).*