Warfarin, organophosphates and organochlorides literature review

Environment, Animals

Warfarin as used in medicine

Warfarin is a drug that serves as an anticoagulant; it is most commonly used in the medical field to prevent thrombosis which is the formation of blood clots and thromboembolism which is the migration of these clots to other parts of the body. It is also used in the management of deep vein thrombosis, arterial fibriation and pulmonary embolism.[1]

This drug is a derivative of dicoumarol a 4-hydroxycoumarin-derived mycotoxin anticoagulant that was discovered in spoiled animal feeds that are made using sweet clover.[2] The recommended dosage is 10mg of warfarin for urgent anticoagulation, after that a maintenance dosage of 5mg is given which is the same as the accepted daily dosing, the letal dose for warfarin is between 50-500 mg depending on the patient.[2]

Warfarin reduces blood coagulation by inhibiting the enzyme vitamin K epoxide reductase which recycles oxidized vitamin K into its reduced state. Vitamin K is oxidized when it is involved in the carboxylation of blood coagulating proteins like prothrombin and factor VII. Warfarin does not inhibit the action of vitamin K but rather inhibits the reduction of oxidized vitamin K back to active vitamin K in real sense Warfarin mainly acts by reducing the amount of active vitamin K in the body that causes blood clotting.[2][3]

This therefore means that the action of warfarin can be reversed by administering vitamin K back into the body. A single dose of Warfarin is administered for 2 to 5 days and the effects begin one day after the administration of the drug. Similarly the reversal of its action requires a similar amount of time, one day.

During the administration of Warfarin outmost care should be taken as warfarin interacts with many foods such as leafy vegetables that contain vitamin K and thus could reverse the action of warfarin. This calls for constant monitoring to evaluate the levels of coagulation. Warfarin is contraindicated in pregnant women as it can pass through the placenta and harm the fetus. The side effects include, hemorrhage, osteoporosis, warfarin necrosis and purple toe syndrome. These are mainly caused by overdosing on the drug and its interactions with other drugs, the bleeding may lead to death if not properly managed.[3]

Warfarin as used in pest control

Warfarin is used as a rodenticide because of its anticoagulant properties it is also preferred because it is tasteless odorless and has a delayed effect which is a very important aspect because pests eat a little bit of something and wait to see the effects. If the rodent doesn’t get sick, it eats again and this is why the delayed effect of warfarin is an important aspect. The lethal dose is between 0. 005% and 0. 1% in first generation pesticides which requires 2-3 days of consecutive consumption to reach the lethal dose.[4]

Anticoagulants can be classified chronic, single dose or multiple doses depending on the speed of action. Warfarin acts by disrupting the vitamin K cycle where it reduces the amount of active vitamin K in the body of the rodent. This results in an inability to produce prothrombin and proconvertin, which are blood clotting factors II and VII.[4]

Huge doses of 4-hydroxycoumarin damage blood capillaries leading to internal bleeding since warfarin has a delayed effect this will occur after a

few days and when the toxic levels are too high the rodent dies due to anemia.[5]

There are however complains about the secondary effects of warfarin especially to pests and wildlife that consume these dead rodents. This is because they are exposed to even higher doses of the toxins produced by warfarin due to bio magnification in the food chain.

2) Discuss the reasons why organophosphorus pesticides have been substituted for organochlorine pesticides in Australia.

Organochlorides are compounds containing at least one covalently bonded atom of chlorine. They are used to make various pesticides such as DDT and lindane.

Organochlorides were first introduced in Australia in the 50’s, they were used in pest control and in the agricultural industries. They were very effective and there use became widespread throughout Australia. However concerns began to arise over health implications of using them.[6]

The first ban was in in the early 60’s due to concerns over residue in animal and poultry products; the ban was on the use of organochlorides on animal foods. This is because they are not easily degradable and can stay in the environment for many years especially in soil and water.[6]

There have also been complains about dangerous human, animal and environmental side effects of organochlorides in Australia. The lethal dose of organochlorines is 5g when it is ingested. The main exposure method is through inhalation, the skin or ingestion. The most susceptible people are the farmers who come into contact with these chemicals when working and those that ingest crops treated using organochlorides. They include blood

dyscrasias, including aplastic anemia and leukemia in humans, anorexia, hepatoxicity and CNS disturbances. [7]There is also the issue that organochlorides are not easily degradable in the environment which causes a lot of pollution the affects wildlife due to bioaccumulation and bio magnification.[6]

In 1972 a report from the Australian academy of science reported that the use of DDT should continue as the benefits outweigh the side effects. However in years to come more and more organochlorides would be banned in Australia due to their negative health effects. [6]

In the 80’s there were still reports of organochloride residue in food crops many years after banning most of them. This strengthened the resolve of the Australian health practitioners to ban even more of the remaining organochlorides. This is because they are listed among persistent organic pollutants (POP) by the UNEP due to their very long half-life in the environment, this lead to the banning of all organochlorides in Australia by the year 2010.[6]

Organophospates are esters of phosphoric acid. They are used to make pesticides, herbicides and nerve gases. As pesticides they are mainly used to make insecticides as they are very toxic to insects. They kill insects by interfering with the nervous system by interfering with the regulation of the regulation of the neurotransmitter acetyl choline. They were mostly preferred because they do not persist in the environment and are degradable when exposed to light.[6]

They gained popularity in Australia after the bans on organochlorides began. This is because they are easily degradable and thus do not stay in the

environment for long this does not mean that they do not have side effects. At the human level organophosphates exposure occurs through ingestion, dermal contact and inhalation.

They cause poisoning by inhibiting acetylcholinesterase , this is the enzyme that is responsible for regulating acetylcholine, this is because they are potent nerve agents. This leads to the accumulation of acetylcholine those results in the overstimulation of muscles which causes disruptions in the cholinergic synapses leading to death. The level of toxicity ranges from an oral LD of < 5 mg/kg to 0. 5 to 5g/kg the symptoms include bradycardia, high blood pressure, headaches, dizziness, convulsions and comas.[8][7]

When the exposure levels are low organophosphates cause reproductive problems especially in farmers such as poor sperm quality and affect the development of unborn children. There have also been reports of increased ADHD in children that are exposed to organophosphates, learning disabilities have also been noted.[9]

Research is still ongoing as there have been cases of poisoning in Australia and claims of long term health effects such as cases of schizophrenia; Alzheimer’s and even cancer, with some even calling for their banning. For now they still continue to be a substitute for organochlorides.[10]

REFERENCES

1. Holbrook AM, Pereira JA, Labiris R, McDonald H, Douketis JD, Crowther M, Wells PS ." Systematic overview of warfarin and its drug and food interactions". Arch. Intern. Med, 2005.

2. Ansell J, Hirsh J, Hylek E, et al. (2008). " Pharmacology and management

of the vitamin K antagonists: American College of Chest Physicians evidence-based clinical practice guidelines (8th Edition)".

3. Holford NH. Clinical pharmacokinetics and pharmacodynamics of warfarin. Understanding the dose-effect relationship. Clin Pharmacokinet 1986; 11: 483–504.

4. Gfeller, Roger W.; Shawn P. Messonnier (2004). Small Animal Toxicology and Poisonings. Mosby. pp. 321–326.

5. Saravanan K, Kanakasabai R, Thiyagesan K . " Field evaluation of difethialone, a new second generation anticoagulant rodenticide in the rice fields", 2003.

6. Echobichon DJ. Toxic effect of pesticides. In: Klaassen CD, ed. Casarett & Doull’s Toxicology: The Basic Science of Poisons. 5th ed. New York: McGraw-Hill; 1996: 659.

7. Goswamy R, Chaudhuri A, Mahashur AA. Study of respiratory failure in organophosphate

and carbamate poisoning. Heart Lung. Nov-Dec 1994.

8. Saadeh AM. Metabolic complications of organophosphate and carbamate poisoning. Trop

Doct. Jul 2001; 31(3): 149-152.

9. Eskenazi B, Bradman A, Castorina R (1999). " Exposures of Children to Organophosphate Pesticides and Their Potential Adverse Health Effects". J Environmental Health Perspectives 107: 409–419.

10. Zwiener RJ, Ginsburg CM. Organophosphate and carbamate poisoning in infants and children.

Pediatrics. Jan 1988; 81(1): 121-126.