Veterinary Toxicology—

To Make a Diagnosis

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Veterinary Toxicology is rapidly becoming recognized as a distinct discipline in veterinary medicine for several reasons. The use of chemicals for agricultural and household purposes has steadily increased during the last two decades, resulting in equally increased opportunities for poisoning in animals. The United States Public Health Service, State Health Organizations and others are alerting the public to the potential hazards of chemical residues in food, thus placing an increased responsibility on the practicing veterinarian to know the toxicology and metabolic fate of the therapeutic agents he administers or prescribes to food producing animals. Increased livestock production with associated changes in management practices may favor plant toxicity problems in certain areas, and may also provide situations favoring infectious or nutritional disorders that are difficult to differentiate from toxicities.

The time has come for veterinary medicine to recognize toxicology as a specialized discipline rather than a branch of physiology or pharmacology. Indeed veterinary toxicology embraces many disciplines presently recognized by veterinary educators, such as physiology, pharmacology, pathology, chemistry, nutrition, and clinical medicine.

The College of Veterinary Medicine at Iowa State University has recognized the inadequacies in our present day understanding, teaching, and research in veterinary toxicology and has taken measures to develop strength in this area. Their objective is to develop a discipline in veterinary toxicology with a three-fold purpose: 1) to develop a strong diagnostic capability, 2) to teach undergraduate and graduate courses in this area, and 3) to develop a comprehensive program of research in veterinary toxicology. To implement these objectives a toxicology section was organized in the Iowa Veterinary Diagnostic Laboratory in 1963 with the establishment of a chemistry-toxicology laboratory. The present staff includes two toxicology chemists and a veterinary toxicologist.

Toxicology cases referred to the Iowa Diagnostic Laboratory provide a perpetual supply of material for teaching and research purposes. This arrangement provides assistance to practicing veterinarians while at the same time defines current toxicological problems.

DIAGNOSIS OF TOXICOLOGICAL PROBLEMS

The accurate diagnosis of toxicities, like many other diseases, is made by utilizing information obtained from five types of evidence. These have been discussed by Radeleff[2] and Burns[1] and are: 1) circumstantial or historic, 2) symptomatic, 3) pathologic, 4) experimental, and 5) chemical. There presently exists a disheartening tendency for some veterinarians to make diagnoses on the basis of information obtained from only one type of evidence, while neglecting to obtain or consider other evidence essential to making a proper diagnosis. The first four types of evidence are commonly used in diag-

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nosing any disorder in livestock. Only rarely is chemical evidence used in diagnosing diseases, however. As a result, veterinarians are understandably less familiar with the advantages, and problems, associated with the use of chemistry in making a diagnosis.

Chemical evidence is often an invaluable aid in diagnosing toxicologic problems. Used properly and in the right perspective, chemical analysis may provide the single most important source of evidence. There are limitations, however, to the value of chemical analyses. Rarely should chemical results be used alone in making a diagnosis. Positive chemical data plus history, symptoms, and lesions may provide evidence to make an accurate diagnosis. One should never request a chemistry laboratory to simply "analyze for poisons" because an animal died of unknown causes. There are thousands of toxic chemicals and plants, and analyses for all of them would be impossible not because of the limited amount of sample available but also because the cost of such analyses is prohibitive. Then too, there are many toxic plants and even some chemical agents for which no chemical analytical procedures are available, and in such cases one must use other types of evidence, such as symptomatic or pathologic evidence to make a diagnosis.

The choice of sample is important in making a chemical analysis. Samples should be taken free of chemical contamination and debris and should not be washed, because of the possibility of removing residues of the toxic agent or of contaminating the sample with the water. Keep in mind that the chemist is often dealing with trace amounts of a particular chemical, and even the slightest contamination may produce erroneous results. Each sample should be individually packaged in glass or plastic to avoid gross contamination or diffusion of toxin from one sample to another. Tissue samples should be frozen and packaged to arrive at the laboratory while still frozen. Serum and blood should not be frozen but kept refrigerated. Plastic bags, newspapers, canned ice, and cardboard boxes are good materials to use for transporting tissue samples to a laboratory for analysis.

If the case involves litigation, additional requirements must be met. Precaution should be taken to assure that the samples were obtained and transported to the laboratory by an unbiased party, and that no possible contamination, either intentional or otherwise, was allowed to reach the sample. Such cases where the owner transports the samples to the chemistry laboratory would be unacceptable in a court of law because of the possibility of intentional adulteration of the specimen. Another important requirement is to notify the laboratory that legal action may be forthcoming, thus enabling the laboratory to handle the case in a manner that will be acceptable in court.

The importance of supplying a complete account of history, symptoms, and lesions with specimens submitted for chemical analysis cannot be over emphasized. Such information will enable the chemist to intelligently select toxicants for which to make ananlyses. This is especially important when a test for the toxicant originally suspected proves negative. The chemist still has the opportunity to test for other poisons if adequate specimens have been submitted.

The best history is of little value, however, unless suitable specimens are available for chemical analysis. If an animal being examined is alive, blood and urine should be submitted. Feces is of little value in most cases. If the animal has died, it is advisable to routinely submit specimens of liver, kidney, and spleen also. In most cases when a chemical analysis is indicated the following specimens should be submitted:

Serum (clot removed)	5 ml
Whole blood	10 ml
Urine	50 ml
Liver	50 gm
Kidney	50 gm
Spleen	50 gm
Stomach or rumen contents	50 gm

Although the above specimens are suitable for the detection of most toxicants, there are instances where special consid-

Table 1.
List of Some Common Toxicants with Accompanying Comments Regarding Special Consideration for Analysis

Toxicant	*Most Important Tissues or Material and Special Comments*
ANTU	Liver and stomach contents; test within 24 hours following ingestion
Ammonia	Whole blood (without ammonia anticagulant) covered with 1 inch of mineral oil; test within 12 hours
Arsenic	Liver and spleen, urine; hair and bone in chronic cases in non-ruminants
Carbon Monoxide	Whole blood, test within 4 hours
Cyanide (prussic acid)	Forage, stomach and rumen contents, whole blood
Copper	Liver, whole blood
Ethylene glycol	One whole kidney, serum, also kidney tissue preserved for histophathology
Fertilizer	Stomach or rumen contents, whole blood
Lead	Liver, whole blood; bone in chronic cases
Methemoglobin	Whole blood; test within 2 hours
Nitrate-Nitrites	Serum, feed and water; tissues are of little value
Oils (fuel, motor, etc.)	Stomach or rumen contents
Oxalates	Serum, one whole kidney; also kidney tissue preserved for histopathology
Pesticides (organic)	Body fat; if cholinesterase inhibitor, whole blood
Phenols (cresols)	Stomach or rumen contents
Phenothiazines	Urine, serum or whole blood
Phosphorus	Stomach or rumen contents, serum
Pindone	Liver
Selenium	Liver, spleen, kidney; hair and hoof in chronic cases
Salt	Serum and cerebrospinal fluid; brain tissue preserved for histopathology
Sodium chlorate	Stomach or rumen contents, whole blood
Sodium fluoroacetate	Liver
Strychnine	Stomach contents, urine
Urea	Whole blood under mineral oil; test within 12 hours; feed sample
Warfarin	Liver

erations are required. Some examples are presented in Table 1.

Interpretation of the significance of chemical data should be done carefully, taking into consideration other evidence present with the case. Positive chemical findings are not always evidence of toxicity, nor are negative findings always indicative that toxicity did not occur. For example, finding chlorinated hydrocarbon insecticides in the fatty tissue of an animal only indicates that the animal was exposed to the pesticide, not that the insecticide produced toxicity. On the other hand failure to find certain organo-phosphorus insecticides in the body tissue would not guarantee that the animal had not been poisoned by such a chemical. In the case of most chlorinated hydrocarbon insecticides, the animal may store a considerable amount of the chemical in its tissue without apparent harmful effects. With organo-phosphorus compounds, the body may metabolize them so rapidly they are not detectable by chemical analysis.

SUMMARY

The veterinarian's clientel deserve an accurate diagnosis. In toxicology cases it is imperative that a thorough history be obtained, that astute observations be made and intelligent questions asked. The veterinarian should apply the professional skill that only he possesses in determining the signs of illness, should perform a thorough post mortem examination, and should follow up by sending properly prepared tissue samples and other suspected materials to a qualified laboratory for chemical and histopathological examination. All information that can be obtained regarding the case should accompany the samples to the laboratory. Cooperation and communication between the laboratory and the practitioner can usually result in a proper diagnosis.

REFERENCES

1. Burns, P. W. 1961 Clinical Diagnosis in Veterinary Toxicology. Proceedings of the American College of Veterinary Toxicologists. pp. 5–12.
2. Radeleff, R. D. 1964. Veterinary Toxicology. Lea and Febiger, Philadelphia.