EPIZOOTIOLOGY IN DISEASE INVESTIGATIONS*

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EPIZOOTIOLOGY is to the animal population what epidemiology is to the human. It is the study of the mass attributes of disease in an animal population. Given a specific disease and the animal population or populations in which it is active, the epizootiologist must identify the etiologic agent and determine the means by which it is transmitted from diseased to susceptible animals; also, the means by which it persists within an animal population and reaches other susceptible groups of animals.

Many factors determine the behaviour of a specific disease agent in a given population: the virulence of the infecting organism, the resistance of the host, the population density of host animals, and the population density of vectors, to name only a few. Scores of variables present, both in the external environment and within the host animal, allow wide variation in the character of disease outbreaks caused by the same etiologic agent. To arrive at an understanding of the way in which these factors interact to influence the course of disease outbreaks, is the problem before the epizootiologist.

EPIZOOTIOLOGICAL CONCEPTS

The acquisition of a number of basic concepts regarding the transmission of disease agents has allowed us to incorporate established facts into working plans for disease investigations. Notable among these are the concepts of contagion discussed by Fracastorius (3); of incubative carriers of disease organisms (2); of healthy carriers of disease agents, applied to Texas fever by Mease (9); of arthropod vectors (12); and of the filterability of viral agents (8). One could list many more. Research in any avenue is stimulated by clear-sighted workers who put forth hypotheses, which, when supported by experimental fact, evolve as theories and finally as broad concepts; as such, they act as guideposts for the direction of subsequent workers.

Concepts have emerged in recent years which have been a great stimulus in directing the epizootiological approach to the study of infectious processes. The idea of wildlife reservoirs of disease agents important to the health of man and his domestic animals have evolved so gradually that it is impossible to credit any one source. The concept of "masked infectivity" as established by Shope (11) has been accepted by many. Not so well-known on this continent is the "doctrine of nidality" of disease organisms, developed by the Russian scientist, Pavlovskii (10). This concept states that disease organisms in general have a home, nest, or *nidus*, in nature, in which infection persists. Among the factors which govern the establishment of a suitable nidus for a particular disease agent are the presence of suitable vertebrate host animals, the presence of vectors, arthropod or other, in suitable numbers, the presence of suitable reservoir host animals in

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which long-term persistence of infection is ensured and suitable topographic and climatologic features for the residence of hosts and vectors and for the survival of organisms outside of their vertebrate or invertebrate hosts (for example, the presence of surface water for the survival of *leptospirae*). Because this nidus requires a typical habitat, often restricted to certain geographic regions with characteristic topography and flora, Pavlovskii has developed a second working concept, which has been referred to as "landscape epidemiology". Application of this concept permits areas suitable for the nidality of certain disease agents to be recognized by their characteristic physical features. For example, areas in which outbreaks of tick-borne encephalitis are likely to occur are found in the Russian steppes. These areas are recognized by their geological formation and forest cover, and secondarily by the abundance of suitable vector ticks and rodent reservoir hosts. Similar principles have been used to characterize areas in which the human population is subject to leptospirosis (rice-growing areas, for example). These two concepts, used extensively by Russian workers, have been discussed at length by Audy (1).

The chief value in the adoption of concepts of this nature lies in their ready application, as tools and guides for investigations, over a wide range of circumstances. Frequently, such concepts can be applied to channel the course of research by which the more specific factors of etiology, such as mode of transmission, are determined.

Emergence of the Zoonoses

Looking upon the advances made in recent years in research on infectious diseases, one is impressed by the fact that the separation once visualized between the diseases of man, his domestic animals, and wildlife, has often been found to be non-existent. In case after case, adequate study of a specific etiologic agent and the disease it produces has shown that the infection once thought to occur only in man, or only in a domesticated species, has in fact, a human host as well as domestic animal hosts; or that it infects both domestic animals and wildlife. This enlightenment has been made possible mainly through the development of laboratory techniques permitting the separation and study of specific etiologic agents. Early recognition of the complete host spectrum of many infectious agents has been impeded by failure in many instances to recognize that totally different disease syndromes may be caused by the same agent in different host species; or that clinically inapparent infections may occur. These latter are of utmost importance in providing reservoir hosts for the perpetuation of disease agents, since in many cases severe illness and death of the host results also in destruction of the offending organism. Eastern equine encephalitis is an example of this. At first recognized only as an infection of horses, later also of man, this virus produces either death or a virus-neutralizing immunity in these two species, with no provision for host-to-host transmission. On the other hand, when infection with this agent was studied in wild birds, it was seen that many avian species experienced only clinically inapparent infections, while providing virus in high titer in their blood for transmission to other birds, to horses and to man by mosquito vectors (7). Carrying this even further, it has been found that experimentally inoculated reptiles show no signs of illness, yet they circulate eastern encephalitis virus at very high levels for prolonged periods of time.

Furthermore, in these animals, the antibody response to the agent is short-lived, allowing the possibility of repeated infection. Evidence of infection in nature has been obtained in the form of neutralizing antibody to the virus, noted in reptiles examined at the time of capture (6). The possible importance of reptiles as reservoir hosts of the equine encephalitides is at present unknown.

Additions to the list of zoonoses, diseases common to man and the lower animals, are being recognized almost daily. Very often the clue to the fact that an agent has a host spectrum which includes man is provided by isolation and identification of the agent from an infected person, or the demonstration of antibody in man to the agent in question. Often the symptomatology and pathology are so different in man and other animals, that little or no information is provided to indicate a common etiological agent. For example, the virus of vesicular stomatitis causes in cattle, swine and horses a disease characterized by vesicular lesions in the mouths and sometimes on the feet and teats of the animals. In man, the same agent produces an influenza-like illness, marked by fever chills, myalgia, headache, and general malaise with rarely, if ever, vesicular erruptions. The first clue leading to the recognition of this disease as a zoonosis was the occurrence of influenza-like illness in personnel handling experimentally infected animals (4). Later it was found that human infection occurred naturally in areas enzootic with respect to the disease (5). Infection in wild animals was also found to occur, and ranged in character from the disease in deer, marked by mouth and foot lesions, to infection in racoons which was clinically inapparent and recognizable only by serologic tests.

Epizootiology in Veterinary Practice

Investigation of a particular disease outbreak in an animal species—cattle, for example—may reveal that not only are the cattle hosts to the infective agent in question but so are some of the other species of animals on the premises, including wild animals, and perhaps even the human residents. Too often the disease investigation stops with the diagnosis and treatment of the cattle or other animals in which the infection was first noticed. In some cases this might be as successful in the final analysis as trying to put out a fire in only the cedar trees of a mixed stand of fir and cedar. The practitioner, however, who faces an outbreak of an infectious disease in a herd of cattle (leptospirosis is a good example) must be governed in his actions by the ever-present force of economics. He may be asked to deal with an abortion storm in a herd of expensive beef cows. It is often not feasible for him to give time and attention also to the possible subclinical infection of a drove of non-pregnant gilts, or perhaps the farmer's dog or cat; nor is it possible for him to conduct research to determine the original source of the infection, which is perhaps some form of wildlife. At this time, a provincial, state, or federal research agency should be contacted—an agency which should be interested and able to conduct suitable research studies as well as to provide diagnostic confirmation.

To enable him to call for, and assist in, the work of research personnel, the practitioner must have some understanding of the epizootiological approaches which might be utilized. This knowledge would govern his co-operation in such measures as the taking of suitable specimens from the animals under his care, the informing of residents of the human health hazards, and the possible need for an

examination of wildlife as a source of infection. Procedures in each investigation must be, of course, governed by recognition of the etiology of the disease in question, the animal species involved and the particular set of environmental circumstances present.

Veterinary educators must realize the needs outlined above, in attempting to provide their students with a knowledge of epizootiological principles and an awareness that asymptomatic interspecific infection often occurs. The practitioner must know that a diagnosis of infection in associated species, other than the animals that he has been called to treat, may be extremely important in the long-term control and eradication of a disease. Furthermore, since identification of associated infection (in the absence of easily recognized signs of illness) often requires specialized laboratory tests, he should know how best to serve his client by calling in research and diagnostic personnel when such assistance is warranted.

Summary

Epizootiological concepts are discussed in the light of their function in facilitating and directing studies on infectious processes in animal populations. The recent discovery of many new zoonoses is the result of an increased emphasis on specific etiology in medical research. Thus, infections have been recognized in both animals and man in which the associated symptomatology and morphologic pathology gave no indication of infection with a common etiologic agent. Clinically inapparent infections, recognizable only by laboratory procedures, may be of utmost importance in the long-term survival or eradication of the agents of disease. Education in the epizootiological approach to problems encountered in veterinary practice is considered a valuable means of promoting co-operation between practising veterinarians and research agencies, especially in situations in which specialized laboratory tests are required, or economics do not permit the practitioner to examine all epizootiological aspects.

Résumé

L'auteur considère les concepts épizootiologiques en rapport avec leur propriété de faciliter et de déterminer l'étude du processus infectieux chez les populations animales. La découverte récente de nouvelles zoonoses est le résultat d'un intérêt accru pour l'étiologie spécifique en recherche médicale. Ainsi, certaines infections ont été signalées tant chez l'animal que chez l'homme, alors que la symptomatologie et la pathologie morphologique n'avaient, toutes d'eux, indiqué aucun signe d'infection par un agent étiologique commun.

Des infections inapparentes à la clinique, dépistées seulement au moyen de tests de laboratoire, peuvent se révéler d'un extrême importance tant pour la survivance à long terme que pour l'éradication des agents de la maladie. L'étude de l'approche épizootiologique aux problèmes rencontrés en pratique vétérinaire semble être un moyen précieux de promouvoir la coopération entre les praticiens vétérinaires et les organismes de recherche, particulièrement dans des cas où les tests de laboratoire sont indispensables, ou lorsque le facteur économique ne permet pas au praticien de considérer tous les aspects épizootiologiques.

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BOOK REVIEW

Practical Animal Husbandry (7th Edition) by William C. Miller, M.R.C.V.S., F.R.S.E., and E. D. S. Robertson, M.R.C.V.S. Edinburgh: Oliver and Boyd. 1959. Pp. 650. Price $7.00. Available from Clark, Irwin and Co. Limited, Toronto.

Veterinarians in large animal practice must be well informed on many aspects of animal husbandry if they are to be recognized as informed consultants on herd management and disease prevention. There is need for a text book written especially to give such information to veterinarians. Unfortunately, this book does not quite fill the needs of practising veterinarians in North America.

The purpose of *Practical Animal Husbandry* is . . . "to guide and aid veterinary or agricultural students, in learning practical methods of controlling, handling and management of each of the more common species of animals kept by man." As far as horses are concerned, this book fulfills the purpose for which it was designed. There is, however, an undue amount of stress on horses considering the number of equine practitioners. Students will find this book a good introduction to practical animal husbandry. Veterinarians who deal primarily with species other than horses may well find that they would like more detail on these species. For example, practitioners who work primarily with cattle will probably use several other methods of restraint (more practical than those outlined in this book) and want more detail on dairy cattle management. While the idea of attempting to include information on husbandry of all domestic animals has much to commend it, nevertheless, the management of small animals, fur animals and poultry is so specialized that it would be better to deal with these species in separate texts.

The printing is good, the type is easy to read and the illustrations, which are mainly on horses, are clear. Students who are interested in learning more about equine husbandry will find this book of value. D.C.M.