METHODS

The Volume of Diagnostic Information and Coefficient of Examination Completeness during Pericardial Inflammation

M. N. Borisevich

Translated from *Byulleten' Eksperimental'noi Biologii i Meditsiny*, Vol. 135, No. 1, pp. 239-240, January, 2003
Original article submitted July 10, 2002

The volume of diagnostic information during pericardial inflammation in small animals was calculated.

Key Words: *diagnosis; volume of diagnostic information; coefficient of examination completeness*

Cybernetic aspect of diagnosis in veterinary presents the process of elimination of diagnosis indeterminacy, which is also called entropy. For example, if a veterinarian has a diagnosis system $A=A_1+A_2+...+A_n$, including n various states, he can exactly determine statistical (*a priori*) probability, $P(A_i)$, of a certain animal disease, A_i, where i=1, 2, 3, …, n, prior to diagnostic examination. The value of $P(A_i)$ allows evaluation of the indeterminacy of the system of various diagnoses for any animal. This indeterminacy is determined by entropy:

$$H_o(A)=-\sum_{i=1}^{n}P(A_i)\times\log_2P(A_i), \quad (1)$$

where $H_o(A)$ is initial entropy (indeterminacy) of the diagnosis system. Minus in formula **(1)** results from $P(A_i)\leq1$, then $\log_2P(A_i)<0$, consequently, the product of these two values is negative, while the entropy remains positive at all $P(A_i)$. Specifically, formula **(1)** shows that the systems including n equiprobable diagnoses possess maximum entropy. For these systems entropy can be calculated by the formula:

$$H_o(A)=-\sum_{i=1}^{n}P(A_i)\times\log_2P(A_i)=-\sum_{i=1}^{n}\frac{1}{n}\log_2\frac{1}{n}=\log_2n. \quad (2)$$

Indeterminacy of the diagnosis system in sick animals decreases after diagnostic examination, because veterinarian receives additional information. This decrease equals to the volume of information accumulated by the doctor during examination.

If the examination clearly revealed A_i diagnosis, which was confirmed with $P(A_i)$ probability, and the probability of other diagnoses differ from zero and have finite values, the entropy of this diagnosis system can be calculated by the formula similar to **(1)**:

$$H(A)=-\sum_{i=1}^{n}P(A_i)\times\log P(A_i). \quad (3)$$

However, this entropy calculated after diagnostic examinations differs from the previous one.

It is important that the volume of information added by diagnostic examination cannot exceed the initial entropy of the diagnosis system.

This means that excessive diagnostic examinations do not provide new information for the diagnosis and are unnecessary for the animal.

In general, the information volume provided by any diagnostic process can be expressed by an equation:

$$I(A)=n\times H_o(A), \quad (4)$$

where $0\leq n\leq1$ is a coefficient of examination completeness. The value of diagnostic coefficient shows times of increase of diagnostic information compared to the initial one. For all real diagnostic processes in veterinary medicine, this coefficient varies from 0

Vitebsk State Academy of Veterinary Medicine

0007-4888/03/1352-0209$25.00

to 1. If n=0, $I(A)$=0, which means that no new information was obtained during diagnostic examination. On the contrary, when this coefficient is equal to 1, the volume of diagnostic information is maximum. This is an ideal case, when examination provides comprehensive data.

For example, the evaluation of the information volume obtained by the diagnosis of pericardial inflammation can be considered. There are two forms of pericarditis: fibrinous (A_1) and exudative (A_2). Sick animal entering a veterinary clinic can equally have any of these forms ($P(A_1)=P(A_2)=0.5$) at $H_o(A)=1$.

A priori probability of the disease and entropy of the diagnosis system after diagnostic examination of each animal was calculated on the base of the data of city veterinary station for small breed pups with symptoms of pericardial inflammation.

Thus, $P(A_1)$ was 0.05, $P(A_2)$=0.95, and $H(A)$=0.28.

The coefficient of examination completeness was 0.72, which means that diagnostic examination of all animals resulted in relatively small volume of useful information. Some important details and unknown or poorly examined signs of the disease could be overlooked. These details comprise 28% of data volume. Thus, the anmalyzed diagnostic process is far from ideal (28% deficit). This offers vast possibilities for the improvement of knowledge even on such well-studied animal disease as pericardial inflammation.