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Newcastle Disease Of Poultry*

Problems In Diagnosis

H. J. Morgan, '47

SINCE its discovery 20 years ago, Newcastle disease has been recognized in at least 16 countries throughout the world. The first reports of its occurrence came from the Dutch East Indies in 1926 followed shortly by an outbreak at Newcastle on the Tyne, England, from which the disease derived its current name. A disease present among chickens in California for the past decade and known by such names as a "respiratory nervous disorder" and "avian pneumoencephalitis" was not recognized as Newcastle disease until 1944.

Except in the United States, one of the outstanding characteristics of this disease has been its extremely high rate of mortality which is nearly always 100 per cent. Probably the chief reason the disease was not recognized sooner in the United States is that the mortality rate among flocks affected here does not approach this high degree of lethality typical in the other countries. The disease has been diagnosed definitely in 17 states by either the virus-isolation or the virus-neutralization tests. These states are California, Connecticut, Delaware, Illinois, Indiana, Maryland, Massachusetts, Michigan, Minnesota, New Jersey, New Mexico, New York, Pennsylvania, Rhode Island, Utah, Washington and Wisconsin. Clinical diagnoses of the disease have been made in a number of other states.

Newcastle disease is now definitely considered to be caused by a virus by those scientists working with it. It is a specific etiological agent, as are the viruses causing such diseases as hog cholera, infectious bronchitis of birds, canine distemper and equine encephalomyelitis.

This virus will attack chickens of all ages, from baby chicks to laying hens, which is also true of turkeys, pigeons, geese, ducks and the other barnyard fowl. The incubation period may vary from 2 to 14 days, the average time generally considered to be about 5 days, with some cases having a longer incubation period.

The first symptoms to appear in chicks from a few days to a few weeks of age are: a difficulty in breathing, with the birds being visibly depressed and weak. Sometimes a marked stupor develops. These symptoms are followed within a few days by twitching of the head and neck along with marked weakness at which time paralysis may occur. Rapid disappearance of the symptoms and recovery or else death occur in a few days. Mortality rate in this country has been reported variously from 10 to as high as 60 per cent. Necropsy reveals that an exudate is usually found in the trachea, the air sac membranes are usually crowded and there seems to be some enlargement of the spleen. The enlargement of the spleen is seen most often in acute cases.

In adult birds the disease is manifested in the beginning by respiratory symptoms and a characteristic abrupt and complete interruption of egg production in laying flocks. Soft-shelled or rough-shelled eggs are to be found, not in the nest, but laid on the hen house floor. The cessation of egg production may persist from 4 to 8 weeks. The birds may go into moult. In these older birds paralysis is less frequently seen and generally the mortality rate is much lower than in chicks. In chickens

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* From United States Department of Agriculture publication, Agricultural Research Administration, Bureau of Animal Industry, Pathological Division, August 30, 1946, entitled "A Review of Newcastle Disease."
which would be classified as fryers and broilers the symptoms resemble those in chicks, with an apparently increased tendency to a more lasting illness, and a greater number of cases of paralysis followed by eventual death. Growth and development are retarded in practically all instances. Some few outbreaks within a flock have been reported to have a death rate as great as 50 per cent.

The disease as it appears in foreign countries is reported to have the characteristic symptoms of a rapid spread within the affected flock, sudden deaths and brief or indefinite preliminary symptoms. This clinical picture of Newcastle disease is rare in the United States according to the available information. Though circumstantial evidence has in some cases indicated that hatcheries may act as disseminating agencies, there is at the present time no proof that the transmission of the disease can occur through the egg, although actually virus have been found in hatching eggs in several instances.

Diagnosis

Newcastle disease cannot be reliably diagnosed from the clinical symptoms in a given lot of sick birds. This disease's close resemblance to infectious bronchitis, laryngotracheitis, and avian encephalomyelitis (epidemic tremor) make it impossible to make an accurate and reliable differential diagnosis. Furthermore, Newcastle disease may resemble fowl leukosis or it may simulate such nutritional deficiencies as encephalomalacia (lack of vitamin E) or arboflavinosis (deficiency of vitamin B2 or riboflavin). The only means of exact diagnosis is, in any case, by laboratory procedures which require technical skill and experience.

The most reliable method of isolating the virus is through injection of embryonated eggs with extracts of the spleen and the brain of recently sickened, living birds. This is the most conclusive evidence of the presence of Newcastle disease. The embryos of the inoculated eggs die in 2 to 6 days, usually with quite characteristic signs of the infection. The virus may be identified conclusively through inoculations of mixtures of the virus and blood serum from birds that have recovered from definitely known Newcastle disease. If such a mixture is injected into incubated fertile eggs, the embryos therein do not die or if the mixture is injected into susceptible chickens, the disease does not develop because the virus being inoculated has been neutralized by antibodies in the blood that came from these recovered, and consequently immune birds. No significant neutralization effect is observed in this test when using serum from birds which have recovered from other diseases, nor from the serum of normal birds. This further brings out the presence of a specific antibody against this specific disease-producing virus. These are the basic principles underlying identification of the Newcastle disease virus by the so-called virus-neutralization test.

There are other means of determining the presence of the Newcastle disease virus. One method is the inoculation of birds that have been previously vaccinated, along with some susceptible birds. The vaccinated birds do not sicken, in contrast to the unvaccinated birds which also were not previously exposed to the disease. The vaccine used in this test may be prepared indirectly or directly from tissues of known infected birds. As a practical diagnostic procedure in the field, this procedure cannot be recommended owing to the dangers involved in housing such infected birds.

Neutralization Test

Another laboratory procedure by which this disease may be identified with reasonable certainty involves the neutralization test. Serum, obtained from birds suspected of having had Newcastle disease, is mixed with known Newcastle disease virus. This mixture is inoculated into embryonated eggs, or into susceptible birds providing there are adequate facilities for their confinement and isolation. If the suspected birds have had Newcastle disease then these inoculated chick embryos or chickens will survive without showing any symptoms indicative of virus infection. However, several weeks are usually required for such virus neutralizing substances (antibodies) to develop in

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significant amounts in the blood of recovered birds. The immunity or at least a significant antibody level in the blood stream usually persists for a considerable time in a recovered bird.

Another test of value in diagnosis makes use of the knowledge that Newcastle disease virus will, under certain conditions, agglutinate or clump together red blood cells of the chicken. Blood serum from birds that have recovered from Newcastle disease frequently prevents this agglutination, so there are actually 2 applications of the phenomenon. While producing valuable presumptive evidence, these tests are not acceptable as a means for exact diagnosis, at least in their present stage of development. There is conclusive evidence that Newcastle disease (avian pneumoencephalitis) is a highly infectious and contagious disease both in the United States and elsewhere in the world. On 2 different occasions, in England and also in Australia, the disease has been eradicated by the familiar and effective technique of prompt slaughter and proper disposal of all infected and exposed birds. The disease is not present in either of these countries at this time. Apparently the disease has become so widely disseminated in the United States than an eradication program of this type on a nationwide scale has been considered economically quite impractical. It is an especially economically unsound control measure, because of the relatively low mortality rate here in the United States.

Distribution

We are, of course, fortunate that the disease has not yet proved to have the disastrous consequences that it has elsewhere in the world. Nevertheless, there is the necessity of recognizing the fact that the virus in North America may achieve a virulence enabling it to produce a characteristic 100 per cent mortality rate as in other countries. It has come to be considered in some of these countries as the No. 1 enemy among poultry diseases. Those acceptable means available for control of the spread of the disease are therefore worthy of consideration by all livestock sanitary authorities, veterinary pathologists and poultrymen alike.

At a national conference held in Washington, D. C., early in May, 1946, by the Department of Agriculture, a national committee comprised of state veterinary officials, poultry pathologists and representatives of the poultry industry was formed. A nationwide application of a vigorous stamping-out policy providing for slaughter of affected and exposed birds was, after due consideration by the committee, considered impractical and inadvisable at this time. However, the committee decided that all reasonable efforts in keeping with the present knowledge of the disease as it exists in this country should be vigorously pursued. Slaughter programs may be applicable to certain areas where the disease is known to be limited in extent, and reintroduction of the infection may be prevented. Quarantine of birds in such areas affected and a disinfection program under the supervision of local authorities should be effective and feasible.

Precautions

It has been recommended that poultry shows and egg laying tests be prohibited in infected areas since it is known that birds having recovered from Newcastle disease may become carriers of the virus. Dr. C. C. Franks, Iowa State veterinarian, prohibited showing of chickens at the Iowa State Fair this year unless they were slaughtered and properly disposed of after the show was over, in an effort to prevent the entrance and redistribution of the virus in the state.

Spread of the Newcastle virus by shipment of diseased, exposed birds; the use of non-sterilized, previously-used feed bags and egg crates; improper disposal of dead birds, and uncontrolled movements of non-disinfected persons or public conveyances has been duly recognized.

Experimental work carried out by the Bureau of Animal Industry in the laboratory and in the field has obtained encouraging results from vaccination against the disease. Under laboratory conditions, vaccination has proved highly effective, although the duration of immunity has been
found to be relatively short in some cases. Vaccination in the field was determined by rather extensive tests to result in a reduction of the mortality rate in the vaccinated birds, as compared to the controls. The loss of egg production, as generally experienced, has been reported to be less in vaccinated than in control birds. It is believed the vaccination will be an aid in limiting the spread of Newcastle disease, with the vaccines now available, and it is expected that through continued experimentation, the vaccinations can be improved. The vaccine is at the present time being produced commercially, though its availability is limited to field trial use. The livestock sanitary authorities should be consulted in this connection.

At present, diagnostic facilities are sorely needed in many areas of the United States in order that the extent of the disease may be determined as promptly and as exactly as possible. While there is no apparent justification for undue alarm in the present situation, it should nevertheless be evident that Newcastle disease problems should continue to receive the considerations due it so that practical solutions will be worked out.

It is estimated the average case of tuberculosis represents a community liability of approximately $10,000. Less than 6 per cent of the families in which the disease occurs are financially able to meet this cost. Accordingly, the taxpayer is paying the bill for tuberculosis whether he realizes it or not.

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