Serologic and Immunologic Response of Wild Waterfowl Vaccinated with Attenuated Duck Plague Virus*

Authors: BUTTERFIELD, W. K., and DARDIRI, A. H.

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Serologic and Immunologic Response of Wild Waterfowl Vaccinated with Attenuated Duck Plague Virus*

W. K. BUTTERFIELD and A. H. DARDIRI

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Abstract

Herring gulls, Canada geese, and mallard ducks were orally vaccinated with attenuated duck plague virus and challenge inoculated with virulent virus. Herring gulls were unaffected by either virus; they did not die or produce detectable antibodies. Geese did not produce antibody to attenuated virus and 11 of 12 died after immunity challenge. Mallard ducks were more resistant as 7 of 9 survived challenge inoculation with virulent virus. No correlation between mortality and antibody produced to attenuated virus vaccine could be observed.

Introduction

The susceptibility of ducks and other wild waterfowl to duck plague has been reported.[10,11,14] Jansen and coworkers showed that vaccination with chicken embryo-adapted virus produced a solid immunity in domestic ducks.[3,4,5,6,9] This study was undertaken to determine the serologic and immunologic responses elicited by vaccination of wild waterfowl with live attenuated duck plague virus.

Materials and Methods

Virus

The Holland attenuated duck plague virus (HAV) used for vaccination was a 1:5 suspension of chorioallantoic membrane (CAM) in amnioallantoic fluid (AAF) harvested from the 4th chicken embryo passage of attenuated virus**.

The Holland virulent challenge duck plague virus (HVV) was a 10^{-1} dilution of CAM in AAF and Hanks' balanced salt solution from the 5th duck embryo passage of virus**.

From the Plum Island Animal Disease Laboratory, Animal Disease and Parasite Research Division, Agricultural Research Service, United States Department of Agriculture, Greenport, New York 11944.

*The Long Island duck disease was designated duck virus enteritis by New York State and ARS regulatory officials [9-Code of Federal Regulations—Part 83—duck virus enteritis (duck plague)].

**Obtained from Dr. J. Jansen, Institute of Infectious Diseases, University of Utrecht, The Netherlands.

Waterfowl

Four white Pekin ducks *(Anas platyrhynchos domesticus)*, 9 mallard ducks *(Anas platyrhynchos)*, 12 Canada geese *(Branta canadensis)*, and 22 herring gulls *(Larus argentatus)* were used.

Inoculation and Immunity Challenge

All wild birds were inoculated *per os* with 2.0 ml. of HAV containing $10^{6.0}$ chicken embryo lethal doses 50% ($CELD_{50}$). The immunity of the birds was challenged 85 days after inoculation *per os* with 1.0 ml. of HVV containing $10^{5.4}$ duck embryo lethal doses 50% ($DELD_{50}$). This virus titered $10^{2.3}$ in 2-week-old Pekin ducks. Four Pekin ducks housed in the same room were not vaccinated with HAV but were challenge inoculated with HVV.

Neutralization Tests

Serum samples were obtained before vaccination, 85 days after vaccination, and 22 days after challenge inoculation. Neutralization tests were performed by the constant serum/variable virus dilution technique as previously described.[2]

Results

Inoculation and Immunity Challenge

The birds appeared healthy following inoculation with HAV. Signs and lesions typical of the disease were observed in Canada geese, Pekin, and mallard ducks dying from immunity challenge with HVV.[7,8] A reddening of the cloacae was observed in the herring gulls. Mortality of birds was as shown in Table 1. It is also noted that *Pasteurella* organisms that were fatal to rabbits were isolated from all the Canada geese that died after immunity challenge.

TABLE 1. *Mortality of avian species following vaccination with attenuated duck plague virus and immunity challenge with virulent virus*

Species	Number dead/number challenge inoculated
Herring gulls	0/22
Mallard ducks	2/9
Canada geese	11/12
Unvaccinated domestic duck controls	3/4

Neutralization Tests

Serums taken from all birds before inoculation were considered negative for duck plague, although serums of 2 mallard ducks had neutralization indices (NI) of $10^{1.1}$ and $10^{1.2}$, respectively. Herring gulls did not develop detectable humoral antibodies to duck plague virus following vaccination or immunity challenge. The Canada geese did not produce antibody following vaccination; however, 22-day postchallenge serum from the surviving goose had a NI of $10^{0.9}$. Neutralization indices of serums from mallard ducks ranged from no detectable antibody to $10^{2.6}$ following vaccination and $10^{0.7}$ to $10^{2.9}$ following immunity challenge (Table 2). The one surviving Pekin duck had a NI of $10^{1.9}$ after immunity challenge.

TABLE 2. *Serologic response of geese and ducks to duck plague virus*

Species	Neutralization Indices (log_{10}/0.1 ml.)		
	Prevaccination	Prechallenge	Postchallenge
Mallard ducks			
1	1.1	0.9	2.9
2	0.2	0.1	2.7
3	N[1]	N	2.7
4	N	2.3	2.6
5	1.2	2.6	2.4
6	0.2	0.4	1.7
7	N	N	0.7
8	N	2.2	S[2]
9	N	N	S
Canada geese			
1	N	N	0.9
2	0.6	N	S
3	0.6	N	S
4	0.4	N	S
5	0.3	N	S
6	N	0.1	S
7	N	N	S
8	N	N	S
9	N	N	S
10	N	N	S
11	N	N	S
12	N	N	S
Unvaccinated Pekin ducks			
1	N	N	1.9
2	N	N	S
3	N	N	S
4	N	N	S

[1] N = No detectable neutralizing antibody.
[2] S = Succumbed to immunity challenge.

Discussion

Apparently, certain waterfowl are more susceptible to duck plague than others as 11 of 12 Canada geese died from immunity challenge while 7 of 9 mallards resisted immunity challenge with virulent virus following vaccination with attenuated duck plague virus. As early as 1930, a carrier state of *Pasteurella* was known to occur in birds.[12,13] The greater mortality in Canada geese may have resulted from the dual infection or symbiosis of the bacteria and the virulent duck plague virus. The attenuated virus administered orally did not elicit any detectable serologic response in geese whereas variation in NI was noted in serums from mallard ducks. One mallard with an antibody level of $10^{2.2}$ at time of immunity challenge succumbed to challenge, whereas 6 mallards with no or negligible antibody levels withstood challenge inoculation. Jansen and Wemmenhove[6] found, in an attenuated virus vaccine study with Pekin ducks, that a low percentage of ducks had positive serum titers one year after vaccination, but the ducks withstood immunity challenge with virulent virus.

As we have observed in this and another study,[2] serums from waterfowl surviving immunity challenge have relatively high antibody levels. It is also noted in this and a previous study[1] that, following challenge inoculation of vaccinated ducks, some anamnestic antibody response may be encountered. An increase in the antibody level in most cases signals infection experience with the virus. The attenuated virus inoculated by the oral route provided protection for most of the mallards. This fact was also observed with Pekin ducks in another study.[1]

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Literature Cited

1. BUTTERFIELD, W. K., and DARDIRI, A. H. 1968. Serologic and immunologic response of ducks to inactivated and attenuated duck plague virus. Bacteriol. Proceed. 68: 161.
2. DARDIRI, A. H., and HESS, W. R. 1967. The incidence of neutralizing antibodies to duck plague virus in serums from domestic ducks and wild waterfowl in the United States of America. Proc. 71st Ann. Mtg. USLSA. 225-237.
3. JANSEN, J. 1964. Het interferentie fenomeen bij de enting tegen eedenpest. (The interference phenomenon in vaccination against duck plague). Tijdschr. Diergeneesk. 89: 376-377.
4. JANSEN, J., Sr. 1964. The interference phenomenon in the development of resistance against duck plague. J. Comp. Path. 74: 3-7.
5. JANSEN, J., and KUNST, H. 1964. Vaccination of ducklings against duck plague by the addition of attenuated virus to the drinking water. Tijdschr. Diergeneesk. 89: 1234-1235.
6. JANSEN, J., KUNST, H., and WEMMENHOVE, R. 1963. The active immunization of ducks against duck plague. Tijdschr. Diergeneesk. 88: 927-932.
7. JANSEN, J., and WEMMENHOVE, R. 1960. The pathology of duck plague. Tijdschr. Diergeneesk. 85: 1560-1564.
8. JANSEN, J., and WEMMENHOVE, R. 1965. Eendepest bij tamme ganzen (Anser anser). [Duck plague in domesticated geese (Anser Anser)]. Tijdschr. Diergeneesk. 90: 811-815.
9. JANSEN, J., and WEMMENHOVE, R. 1966. De immuniteit ruim een jaar na enting tegen eendenpest. (The immunity, a good year after vaccination against duck plague). Tijdschr. Diergeneesk. 91: 838-841.
10. LEIBOVITZ, L. 1968. Progress report: Duck plague surveillance of American anseriformes. Bull. Wildlife Dis. Assoc. 4: 87-90.
11. LEIBOVITZ, L., and HWANG, J. 1968. Duck plague in American anseriformes. Bull. Wildlife Dis. Assoc. 4: 13-14.
12. PRITCHETT, I. W., BEAUDETTE, F. R., and HUGHES, T. P. 1930. The epidemiology of fowl cholera. IV. Field observations of the "spontaneous" disease. J. Expt. Med. 51: 249-258.
13. PRITCHETT, I. W., BEAUDETTE, F. R., and HUGHES, T. P. 1930. The epidemiology of fowl cholera. V. Further field observations of the spontaneous disease. J. Exptl. Med. 51: 259-274.
14. VAN DORSSEN, C. A., and KUNST, H. 1955. Over de gevoeligheid van eenden en diverse andere watervogels voor eendenpest. (Susceptibility of ducks and various other waterfowl to duck plague virus). Tijdschr. Diergeneesk. 80: 1286-1295.