

PATHOGENICITY OF THE CANADIAN DELMARVA (DMV/1639) STRAIN OF INFECTIOUS BRONCHITIS VIRUS (IBV) FOR LAYING HENS

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SUMMARY

Infectious bronchitis virus (IBV) can significantly impact the reproductive performance of laying hens. The infecting IBV strain, age at infection and status of immunity are the major factors that influence the outcome regarding the induction of reproductive disease. Over the past few years, DMV/1639 strain has been identified in flocks presenting with false layer syndrome in Eastern Canada. The aim of this study was to investigate the pathogenicity of the DMV/1639 strain for the reproductive tract of young and adult laying hens. One-day-old and 29-week-old specific pathogen-free (SPF) hens were challenged oculo-nasally with the Canadian DMV/1639 strain. Infection of the young chickens showed wide tissue tropism to the respiratory, urinary, genital, and alimentary tracts at 7 days post-infection (dpi). Necropsy conducted at 16 weeks of age showed marked cystic lesions in the oviduct. Microscopical investigation revealed epithelial sloughing, mononuclear cell infiltrations, and cystic dilated glands in the oviduct. Virus persistence was detected in the cecal tonsils with continuous cloacal viral shedding. In the infected adult hens, the egg production dropped to 40% at 5 dpi. Necropsy conducted at 10 dpi showed regression of the ovary and atrophy of the oviduct. Histopathological changes involved heterophilic and mononuclear cell infiltrations, sloughed epithelium, and degenerated glands in the oviduct. Overall, the study shows that infection of young and adult chickens with the Canadian DMV/1639 strain of IBV induces significant reproductive tract pathologies and negatively impacts layer reproductive performance.

INTRODUCTION

The Canadian DMV/1639 strain of infectious bronchitis virus (IBV) has recently been identified in several layer flocks with egg production problems in Eastern Canada (5, 6). Necropsy examination of birds from these flocks showed high incidence of cystic left oviducts. These lesions have been previously reported

in layers when infected at very young age (less than 3 weeks) (3, 8). A few IBV strains, particularly those belonging to the QX genotype, are known to induce these types of lesions (1). The initial DMV/1639 isolate was identified in a nephropathogenic infectious bronchitis outbreak in Delmarva peninsula, USA in 2011 (4). It was not until 2015 that the DMV/1639 strain was associated with infection of the reproductive tract. In addition to the IBV strain involved in infection, the age at infection is a significant factor in the induction of reproductive disease.

The aim of this study was to investigate the pathogenicity of the Canadian DMV/1639 strain for the reproductive tract of young and adult laying hens.

MATERIALS AND METHODS

Experiment 1. Forty 1-day-old SPF chicks were divided equally into two groups. The infected group was challenged oculo-nasally with 1×10^6 EID₅₀ of the Canadian DMV/1639 strain in 100 μ l. The control group was mock inoculated with PBS. Birds in both groups were monitored daily for clinical signs. Oropharyngeal (OP) and cloacal (CL) swabs were collected weekly from both groups. At 7 dpi, five birds from each group were euthanized. All remaining birds were euthanized at 16 weeks of age. During postmortem examination, trachea, lung, kidney, cecal tonsils, ovary, and oviduct were collected for histopathological examination and quantification of viral load by qPCR.

Experiment 2. Twenty 29-week-old SPF laying hens were divided equally into two groups. Viral/mock (dose and route) inoculation was performed as described in experiment 1. Birds in both groups were monitored daily for clinical signs and egg production for 10 dpi. OP and CL swabs were collected at 3, 5, and 10 dpi. At 5 and 10 dpi, five birds from each group were euthanized. During postmortem examination, reproductive organs (ovary and oviduct) were collected for histopathological examination and quantification of viral load by qPCR.

All statistical analyses were conducted at a 0.05 level of significance.

RESULTS

Experiment 1. Significantly higher clinical signs scores were recorded in the infected group between 3 to 7 dpi compared to the control group. Approximately 60%–70% of the infected birds shed the virus through OP and CL routes until 28 dpi and 98 dpi, respectively. The IBV genome load was quantifiable in all tissues of the infected birds collected at 7 dpi. The presence of the IBV antigen in the infected tissues was confirmed using immunofluorescence staining. At 16 weeks of age, cystic lesions of varying sizes were detected in 46% of the oviducts of the infected birds. Microscopical examination showed epithelial sloughing and mononuclear cell infiltrations in the infected ovary and oviduct in addition to cystic dilated glands in the infected oviduct. The control group remained IBV negative and showed no clinical signs, gross or microscopic lesions throughout the experiment.

Experiment 2. The infected birds were lethargic starting at 4 dpi. The egg production was between 20% to 60% in the infected group starting at 5 dpi. While no gross lesions were detected in the infected birds at 5 dpi, two birds had regressed ovary and atrophied oviduct at 10 dpi. A significant increase in the IBV genome load was detected in the infected oviduct at 10 dpi compared to at 5 dpi. Histopathological changes involved heterophilic and mononuclear cell infiltrations, sloughed epithelium, and degenerated glands in the infected oviduct. The control group remained IBV negative and had > 80% egg production throughout the experiment.

DISCUSSION

In the provinces of Ontario and Quebec, the prevalence of the DMV/1639 IBV strain in egg-laying flocks has been correlated to the low peak production (40%–77%) (7). Our findings corroborate field observations, in which infection of 1-day-old chicks with the Canadian DMV/1639 strain resulted in a significant rate of cystic formation in the oviducts of growing pullets. These chickens are usually unproductive (false layers), and affected flocks are often culled (2). The pathogenicity of the Canadian DMV/1639 strain to the reproductive tract of adult hens was also confirmed. When the chickens were challenged during peak egg production, there was a considerable decline in egg production, as well as

distinctive gross and histological lesions in the reproductive tract.

Overall, infection of young and adult chickens with the Canadian DMV/1639 strain of IBV causes substantial reproductive tract abnormalities and lowers layer reproductive performance.

(The full-length article of experiment 1 was published in *Viruses*, and a full-length article of experiment 2 will be published in *Virology*.)

REFERENCES

1. Benyeda, Z., T. Mato, T. Suveges, E. Szabo, V. Kardi, Z. Abonyi-Toth, M. Rusvai, and V. Palya. Comparison of the pathogenicity of QX-like, M41 and 793/B infectious bronchitis strains from different pathological conditions. *Avian Pathol* 38:449-456. 2009.
2. Crinion, R. A., R. A. Ball, and M. S. Hofstad. Abnormalities in laying chickens following exposure to infectious bronchitis virus at one day old. *Avian Dis* 15:42-48. 1971.
3. Crinion, R. A., and M. S. Hofstad. Pathogenicity of four serotypes of avian infectious bronchitis virus for the oviduct of young chickens of various ages. *Avian Dis* 16:351-363. 1972.
4. Gelb, J., Jr., B. S. Ladman, C. R. Pope, J. M. Ruano, E. M. Brannick, D. A. Bautista, C. M. Coughlin, and L. A. Preskenis. Characterization of nephropathogenic infectious bronchitis virus DMV/1639/11 recovered from Delmarva broiler chickens in 2011. *Avian Dis* 57:65-70. 2013.
5. Hassan, M. S. H., D. Ojkic, C. S. Coffin, S. C. Cork, F. van der Meer, and M. F. Abdul-Careem. Delmarva (DMV/1639) Infectious Bronchitis Virus (IBV) Variants Isolated in Eastern Canada Show Evidence of Recombination. *Viruses* 11. 2019.
6. Parent, E., A. Gagnon-Francoeur, B. Lanthier, G. Hébert, S. Buczinski, and M. Boulianne. Diagnostic Accuracy of Ultrasonography to Detect False Layers in a Commercial Laying Flock Infected by an Infectious Bronchitis Virus Delmarva Genotype Causing Cystic Oviducts. *Avian Dis* 64:149-156. 2020.
7. Petrik, M. Clinical Presentation of False Layer Syndrome Caused by Infectious Bronchitis. In *Proceedings of the AVMA/American Association of Avian Pathology Annual Meeting, Denver, CO, USA*. 2018.
8. Zhong, Q., Y. X. Hu, J. H. Jin, Y. Zhao, J. Zhao, and G. Z. Zhang. Pathogenicity of virulent infectious bronchitis virus isolate YN on hen ovary and oviduct. *Vet Microbiol* 193:100-105. 2016.

Figure 1. Cystic formation in the oviduct (16 weeks of age) of a chicken infected with the Canadian DMV/1639 strain of IBV at 1-day of age.

