Study on the control of high pathogenicity and low pathogenicity avian influenza in Vietnam

(ベトナムにおける高病原性および低病原性鳥インフルエンザの制御に関する研究)

Le Trung Kien

Summary

To develop an effective AI control strategy, circulation dynamics and AIV characteristics should be considered carefully. In detail, numerous well-known studies of AI figured out the damage and relative risk of HPAI in poultry. Originally, stamping out is the high priority for combating HPAIV, and vaccination is an optional measure because mass vaccination in the complex situation in the field may facilitate antigenic drift caused by immunological selection pressure. Unlike HPAIV, LPAIV antigenicity was more conserved due to the local infection, which induces a relatively low selection pressure. However, LPAIVs play a critical role in generating the potential pandemic strains by contributing genetic diversity via reassortment. Thus, the control strategy for LPAIV might consider reducing its prevalence using the vaccine as an optional countermeasure. Unfortunately, research on the genetic diversity and potential risk of LPAIV only played a minor role in the overall research on AIV. Therefore, the scientific evidence related to the evolution rate and factors affecting the evolution dynamic of LPAIV remains unclear. This study applies a multi-aspect approach for improving AI control strategy in Vietnam. By combining the virological and epidemiological studies, the findings of this thesis provide a new perspective for improving AI control and prevention.

The genetic diversity of LPAIV was assessed in Chapter I. A total of 1,361 AIVs of various subtypes were isolated in the surveillance from 2014 to 2018, in which H6 and H9 viruses were the dominant subtypes and H7N7 viruses were initially detected. The phylogenetic analysis of the HA genes revealed that Vietnamese H6 and H9 LPAIVs were classified into Group II and Y280/BJ94 sub-lineages, respectively, and clustered together with previous isolates in Vietnam and neighboring countries. H7 LPAIVs were clustered together with Cambodian isolates, but not with H7 LPAIVs previously isolated in Vietnam or Chinese H7N9 HPAIVs. The antigenicity of Vietnamese H6 and H7 viruses showed a slight diverse and formed into different antigenic groups from preexisting viruses, whereas H9 viruses isolated during the study period were almost identical. Conserved antigenicity of H9 isolates from poultry suggested that the viruses were maintained in the immunologically naive poultry population in Vietnam despite the high prevalence of H9 viruses. However, concerns regarding the damage caused by H9 viruses were raised due to the field reports from DAH that AI-typical clinical signs were

observed in the outbreak with a diagnosis of influenza A only. Although H9 viruses were classified as LPAIV, they could cause severe damage due to co-infection with other pathogens in the field. Therefore, to understand the pathogenesis of H6 and H9 LPAIVs in the field, experimental infection with or without other pathogens to poultry will be performed.

Unfortunately, a previous study in Vietnam indicated that interventions applied in LBMs were not effective enough to minimize the risk of AIVs. Therefore, the identification of stakeholders' contributions that increase the likelihood of AIV isolation in individual birds was the target of Chapter II. In the study area, birds sampled from PDSs had the highest prevalence (21.0%), followed by LBMs (14.0%), backyard farms (3.0%), and commercial poultry farms (0.6%). Adequate knowledge of AI was identified as a protective factor by demonstrating that respondents with a mixed (uncertain or inconsistent) level and a low level of knowledge about AI increased odds of birds being AIV positive compared to a good knowledge of AI respondents. These findings confirm the hypothesis that insufficient knowledge of AI might increase the risk of AIV positivity. To assist in this regard, the AI control strategy should focus more on PDSs by providing appropriate education programs specifically designed for those in each enterprise.

The risk factors of LPAI have not been precisely evaluated due to the underestimation of its spread and damage in farms. Therefore, the risk factors of LPAI in farms were investigated in Chapter III. A total of 2,019 AIVs were isolated from 2009 to 2019, with an overall prevalence of 7.7%. The distribution of subtypes differed between northern and southern Vietnam, with subtype H9 being the remarkably dominant subtype in the north, while H6 and H9 subtypes were equally circulating in the south. The epidemiological survey emphasized that raising aquatic birds, particularly Muscovy ducks, might increase the risk of LPAIV infection, whereas good behavior of reporting AI events and supporting AI control policy had a protective effect against LPAIV infection in farms. The differences in the distribution of host species in specific regions and the beliefs of the farmers in countermeasures implementation by the local authority indicated that locally specific control measures are effective for LPAIV circulation.

Finally, the necessity of AI control is undisputed but enhancing the effectiveness of countermeasures is a challenging task. Therefore, collaboration with multiple stakeholders employing different approaches should be the mainstream spirit in AI control strategy development. Thus, the findings in this thesis provide more information regarding the evolution and impact of AIVs in the fields, which might contribute to improving the AI control strategy in Vietnam.