REDVET - Revista electrónica de Veterinaria - ISSN 1695-7504
Vol 23, No. 3 (2022)
http://www.veterinaria.org
Article Received: 10 April 2022; Revised: 05 May 2022; Accepted: 30 May 2022; Publication: 27 August 2022

Proper Vaccination Timing Against Newcastle Disease in Regard to Maternal Immunity

Zaid Yaseen Ibrahim[1]
Hadeel Mohammed Fayyadh[2]
[1,2] University of Fallujah / College of Veterinary Medicine, Iraq, Fallujah
drzaidvet@gmail.com

Abstract

Newcastle disease (ND) is an economically important viral illness because it causes large production losses in affected poultry farms. Biosecurity and vaccination are considered the main ways for controlling infection with newcastle disease virus (NDV). The success of the vaccination process in early days of age depends on several factors. One of those factors is the serum level of the maternal antibodies (MAb). Our study was conducted to measure the MAb in Iraqi commercial poultry as a method of determining the proper age for first vaccination. Our data resulted in a mean age for proper vaccination of 11.1±0.88 day. The results were disperse and the proper vaccination age ranged from 4.8 to 22.8 days. For this reason, we recommend performing serologic test for MAb to properly design vaccination programs.

Keywords: Maternal Immunity, Newcastle disease, Hemagglutination inhibition

Introduction

Newcastle disease is a viral disease that infects many types of birds and cause respiratory, digestive and nervous symptoms. Signs, lesions and mortality are variable and depend on, among other factors, the virulence of the infecting strain and dose of the virus; species, immunological condition and age of the host; and route of infection (Suarez et al., 2020). ND is worldwide in distribution and only 16 countries were the disease has never been reported (Ibrahiem, 2016). Vaccination against NDV is the main measure to protect poultry flocks in endemic areas (Senne et al., 2004). Many factors lead to the success of the vaccination process these include: the level of MAb, type of bird, type of vaccine, method of vaccination and other factors (Al-Garib et al., 2003).

The titer of MAb in chicks correlates to the level of antibodies (Ab) circulating in the blood of parent stocks (Giambrone & Closser, 1990). This depends on the vaccination program used in the breeders flocks and whether or not those flocks were infected with NDV. Consequently, MAb will be variable from one farm to another. High levels of MAb in newly hatched chicks will interfere the vaccination process by neutralizing the vaccine virus (Vrdoljak et al., 2017). Therefore, in order for the vaccination process to be reliable, timing of vaccination must be determined by measuring the MAb titer in chicks.

Several methods for measuring MAb titer are available. The haemagglutination inhibition (HI) test is the most commonly employed test in ND serology. Enzyme-linked immunosorbent assays are also used and there are a variety of commercial test kits available. (OIE, 2021).

In Iraq, the practice of measuring MAb titers before designing vaccination programs is rarely used especially in poorly planned, traditional, small scale houses. For this reason, this study was conducted to survey the levels of MAb titers in commercial poultry farms and to provide

REDVET - Revista electrónica de Veterinaria - ISSN 1695-7504
Vol 23, No. 3 (2022)
http://www.veterinaria.org
Article Received: 10 April 2022; Revised: 05 May 2022; Accepted: 30 May 2022; Publication: 27 August 2022

reasonably reliable timing for the first NDV vaccine in farms were MAb levels are not measured.

Materials and Methods

Sampling

Blood samples of 220 were collected from 22 poultry farms located in Anbar province, Iraq. Samples were centrifuged and blood serums were transferred to new tubes ready for serology.

Serology

The Hemagglutination Inhibition (HI) test was used to determine MAb titer in serum samples. HI procedure described by Grimes (2002) was followed.

Determining the age of vaccination

According to Allen et al. (1978) MAb HI titer of 2^3 does not interfere with the vaccination process and if the titer is higher than 2^3 the time required for the titer to decrease one log is 4.5 days. For example, if the titer is 2^5 it would take 9 days for the MAb to decrease to 2^3. Accordingly, The following equation was used to calculate the proper vaccination age:

$$\textit{Proper vaccination age}(\textit{days}) = [(\log 2\, \textit{HI Titer Mean} - 3) \times 4.5] + \textit{Age at sampling}$$

Statistical analysis of data

The data were analyzed by descriptive tests using the statistical software JASP (University of Amsterdam, 2022).

Results

Samples were collected from 22 farms (Table 1). The age of chicks at the day of sampling ranged from 3 to 7 days and averaged 5±0.22 days. HI test results expressed as Log2 ranged from 3 to 6.5 and averaged 4.31±0.12. Based on HI test results, the average recommended age for first vaccination was 11.1±0.88 days.

A demonstrated in the boxplot in Figure 1, the calculated proper age for first vaccination ranged from 4.8 days to 17.7 days with the exception of the biased result for farm number 2 which was 22.8 days. Moreover, 50% of the farms have a proper vaccination age between 9.3 days and 13 days . Those 50% are represented in the green box in the boxplot while the line in middle of the box represent the median which was 10.1 days.

REDVET - Revista electrónica de Veterinaria - ISSN 1695-7504
Vol 23, No. 3 (2022)
http://www.veterinaria.org
Article Received: 10 April 2022; Revised: 05 May 2022; Accepted: 30 May 2022; Publication: 27 August 2022

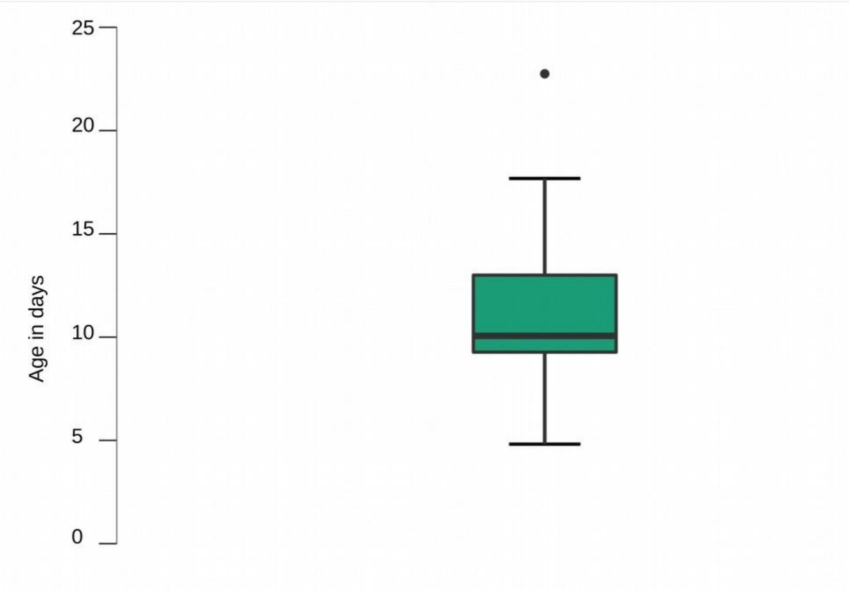

Figure 1: A boxplot represents the distribution of the recommended age for vaccination in days

Table 1: The age at first vaccination in days that is recommended for each farm .

Farm Number	Age at sampling (days)	Log2 HI Titer (Mean±SE)	Recommended Age for Vaccination (days)
1	4	5.0±0.33	13.0
2	7	6.5±0.27	22.8
3	6	3.7±0.24	9.3
4	6	4.6±0.24	13.0
5	5	5.8±0.23	17.7
6	5	4.4±0.53	11.5
7	6	3.8±1.20	9.7
8	5	4.6±0.40	12.2
9	5	4.9±0.31	13.6
10	3	4.0±0.23	7.5
11	5	5.3±0.36	15.5
12	4	3.2±0.26	4.8
13	5	5.3±0.20	15.2
14	6	3.7±0.24	9.3
15	7	3.7±0.29	10.2
16	5	4.1±0.21	9.9
17	6	3.8±0.20	9.6

18	5	4.0±0.30	9.5
19	7	3.0±0.33	7.0
20	4	3.6±0.24	6.9
21	4	3.5±0.19	6.3
22	5	4.3±0.36	10.7

Discussion

Although many countries tightened import restrictions on live chickens, eggs, and poultry meat. and inforced biosecurity practices, Vaccination remains very important in the control strategy of newcastle disease (Mayers et al., 2017; Suarez et al., 2020). There is general agreement among researchers that high MAb titer transferred from hens to their progeny will lead to neutralization and interference with newcastle disease vaccinal antigens when vaccination is done before the titer wane (Al-Garib et al., 2003; Allan et al., 1978; Awang et al., 1992; Dimitrov et al., 2017; Oni & Adedipe, 2012; Rahman et al., 2002). Maternal Immunity is passively acquired Ab from mothers to the offspring. In humans, MAb are transferred prior to delivery through the placenta (Niewiesk, 2014). In farm animals , through absorption of IgG in the intestine from colostrum within the first 24 h after birth (Grindstaff et al., 2003).

Birds pass on MAb to their chicks by storing immunoglobulin in their eggs. (Hamal et al., 2006). Consequently, it is recommended to design vaccination programs based laboratory measurement of MAb titer; otherwise, in the absence of laboratory testing, it is advised to administer the vaccine through the conjunctival and intranasal routes to elicit local immunity (Dimitrov et al., 2017).

Since there was wide range of MAb titer in our data, we concluded that it is difficult to calculate a proper age for first vaccination against NDV without carrying-out a serologic test. In cases of small-scale farms and when there is no ability to conduct serologic tests, we recommend delaying the vaccination after at least 11 days and focusing on enhancing bio security practices during early days of the birds' life.

References

[1]. Al-Garib, S. O., Gielkens, A. L. J., Gruys, E., & Kochi, G. (2003). Review of Newcastle disease virus with particular references to immunity and vaccination. *World's Poultry Science Journal*, *59*(2), 185–200.

[2]. Allan, W. H., Lancaster, J. E., & Toth, B. (1978). Newcastle disease vaccines. Their production and use. Food and Agriculture Organization of the United Nations.

[3]. Awang, I. P. R., WS, W. A. K., & Razak, A. (1992). Detection of maternal antibody against Newcastle disease virus in chicks using an indirect immunoperoxidase test.

[4]. Dimitrov, K. M., Afonso, C. L., Yu, Q., & Miller, P. J. (2017). Newcastle disease vaccines—A solved problem or a continuous challenge? Veterinary Microbiology, 206, 126–136.

[5]. Giambrone, J. J., & Closser, J. (1990). Effect of breeder vaccination on immunization of progeny against Newcastle disease. Avian Diseases, 114–119.

[6]. Pawan Kumar Tiwari, P. S. . (2022). Numerical Simulation of Optimized Placement of Distibuted Generators in Standard Radial Distribution System Using Improved Computations. International Journal on Recent Technologies in Mechanical and Electrical Engineering, 9(5), 10–17. https://doi.org/10.17762/ijrmee.v9i5.369

[7]. Grimes, S. E. (2002). A basic Laboratory Manual for the small-scale production and testing of 1-2 Newcastle disease vaccine. FAO Regional Office for Asia and the Pacific (RAP). https://www.fao.org/3/ac802e/ac802e.pdf

[8]. Grindstaff, J. L., Brodie Iii, E. D., & Ketterson, E. D. (2003). Immune function across generations: Integrating mechanism and evolutionary process in maternal antibody transmission. Proceedings of the Royal Society of London. Series B: Biological Sciences, 270(1531), 2309–2319.

[9]. Hamal, K. R., Burgess, S. C., Pevzner, I. Y., & Erf, G. F. (2006). Maternal antibody transfer from dams to their egg yolks, egg whites, and chicks in meat lines of chickens. Poultry Science, 85(8), 1364–1372.

[10]. Agarwal, D. A. . (2022). Advancing Privacy and Security of Internet of Things to Find Integrated Solutions. International Journal on Future Revolution in Computer Science &Amp; Communication Engineering, 8(2), 05–08. https://doi.org/10.17762/ijfrcsce.v8i2.2067

[11]. Ibrahiem, Z. Y. (2016). Molecular detection of Avian Influenza virus, Newcastle disease virus, Infectious bronchitis virus and Mycoplasma gallisepticum in broiler flocks with airsacculitis [M.Sc Thesis]. University of Baghdad.

[12]. Mayers, J., Mansfield, K. L., & Brown, I. H. (2017). The role of vaccination in risk mitigation and control of Newcastle disease in poultry. Vaccine, 35(44), 5974–5980.

[13]. Niewiesk, S. (2014). Maternal antibodies: Clinical significance, mechanism of interference with immune responses, and possible vaccination strategies. Frontiers in Immunology, 5, 446.

[14]. OIE. (2021). Newcastle disease (infection with newcastle disease virus). In Manual of Diagnostic Tests and Vaccines for Terrestrial Animals 2021. World Organization for Animal Health. https://www.oie.int/fileadmin/Home/fr/Health_standards/tahm/3.03.14_NEWCASTLE_DIS.pdf

[15]. Sharma, A. . (2022). On the Computation of Bijective Probability Spaces. International Journal on Recent Trends in Life Science and Mathematics, 9(1), 47–63. https://doi.org/10.17762/ijlsm.v9i1.141

[16]. Oni, O. O., & Adedipe, O. D. (2012). Role of maternally derived antibody in Newcastle disease vaccination. Nigerian Veterinary Journal, 33(2).

[17]. Rahman, M. M., Bari, A. S. M., Giasuddin, M., Islam, M. R., Alam, J., Sil, G. C., & Rahman, M. M. (2002). Evaluation of maternal and humoral immunity against Newcastle disease virus in chicken. Int. J. Poult. Sci, 1(5), 161–163.

[18]. Senne, D. A., King, D. J., & Kapczynski, D. R. (2004). Control of newcastle disease by vaccination. In Control of infectious animal diseases by vaccination (Vol. 119, pp. 165–170).

[19]. Suarez, D. L., Miller, P. J., Koch, G., Mundt, E., & Rautenschlein, S. (2020). Newcastle disease, other avian paramyxoviruses, and avian metapneumovirus infections. Diseases of Poultry, 109–166.

[20]. University of Amsterdam. (2022). JASP (0.12) [Computer software]. https://jasp-stats.org/

[21]. Inna Rakhmawati, Anak Agung Ayu Mirah Adi, Ida Bagus Oka Winaya, Palagan Senopati Sewoyo. (2022). In Vivo Oncolytic Potency of Newcastle Disease Virus Gianyar-1/AK/2014 Virulent Strain Against Mice Fibrosarcoma Models. Revista Electronica De Veterinaria, 56 - 63. Retrieved from https://www.veterinaria.org/index.php/REDVET/article/view/139

[22]. Vrdoljak, A., Halas, M., & Süli, T. (2017). Vaccination of broilers against Newcastle disease in the presence of maternally derived antibodies. Tierärztliche Praxis Ausgabe G: Großtiere/Nutztiere, 45(03), 151–158.