Indian Journal of Animal Sciences **84** (11): 1163–1165, November 2014/Article

Comparative efficacy of three lentogenic Newcastle disease vaccine regimens in turkey poults

VANUSYA[1], R ASHA RAJINI[2] and J JOHN KIRUBAHARAN[3]

Tamil Nadu Veterinary and Animal Sciences University, Chennai, Tamil Nadu 600 007 India

Received: 28 September 2013; Accepted: 18 July 2014

ABSTRACT

The study was undertaken to assess the relative efficacy of 3 vaccination regimens in turkey poults in a tropical country, using 3 different lentogenic ND vaccines. At 2 weeks of age, 24 poults from each group received primary vaccination with either F or LaSota or D 58 via eye/nasal drops. Humoral immune response was assessed by haemagglutination inhibition (HI) test. In all unvaccinated control groups, antibody titre waned by third week of age. All the 3 lentogenic vaccines elicited significant primary humoral immune response. Peak titre was observed at second week of post vaccination in D58 group and by third week post vaccination in RDVF and LaSota groups. All groups that had received LaSota booster vaccine showed significant anamnestic humoral immune response. It was observed that due to early induction in immune response in poults, D58 could be used as potential primary vaccine.

Key words: Humoral immune response, Poults, Primary vaccines, Tropics

Newcastle disease (ND) and ND virus (NDV) infections were reported earlier in turkeys (Balachandran *et al*. 2007). NDV infection in turkey breeder hens adversely affects egg production and egg shell quality (Kelleher *et al*. 1988). Moreover, isolation of velogenic NDVs from farm turkeys (Kumanan *et al*. 2004) suggested that turkeys could act as potential reservoirs of such viruses and likely to transmit to chickens. Therefore, preventing NDV infection in turkeys by use of appropriate vaccine is essential. The general practice in turkey farms is to use commercial lentogenic chicken vaccines based on their efficacy data obtained from chickens. Furthermore, there is no consensus about ND vaccination regimen existing among turkey farms in India and ND vaccines are used empirically. This has lead to frequent outbreaks of ND and associated production losses due to inadequate protective serum antibodies.

The empirical use of ND vaccines in turkeys in India is largely due to missing performance data of ND vaccines, obtained from commercial strains of turkeys reared indigenously. For this reason, we investigated the humoral immune response of Beltsville small white turkeys against 3 different ND vaccination regimens consisting of priming with 3 different lentogenic vaccines, viz. F, LaSota and D 58 and common booster with LaSota (Ghumman *et al*. 1976). Literature on use of different vaccine regimens in turkey is scarce, therefore in this study a systemic approach was adopted to develop a suitable schedule of vaccination for turkey poults.

Present address: [1]Veterinary Assistant Surgeon (anushya @gmail.com), Department of Animal Husbandry; [2]Professor (professorasha@gmail.com), Department of Poultry Science; [3]Professor (jjohnk@gmail.com), Department of Veterinary Microbiology, Madras Veterinary College.

MATERIALS AND METHODS

Turkey poults were allocated into 4 groups. Three groups (viz., LaSota, RDVF and D58 groups) had 36 birds each and the fourth group had 24 birds. Day-old Beltsville small white turkey poults (36) were allocated into each of the 3 groups (Fig.1) Pooled serum sample was collected from randomly selected 12 birds in each major group at seventh day of age to assess the maternal antibody titre. Blood collection was done from jugular vein. Post vaccination serum samples from individual birds were collected at weekly intervals up to 12th week of age.

Blood collection was done from wing vein. Serum samples were stored at –2°C. The D58 virus propagated in 9- to 11-day-old embryonated chicken eggs was harvested from allantoic fluid and used as viral antigen in HA and HI test. Hyperimmune serum raised against NDV in chickens was provided by the Department of Veterinary Microbiology, Madras Veterinary College, Chennai. The HI titre of the serum was $2^{10.0}$.

At 2 weeks of age, 24 poults from each group received primary vaccination either with F or LaSota or D 58 via eye/nasal drops. D 58 is a thermostable oral pellet ND vaccine strain, developed by Department of Veterinary Microbiology, Madras Veterinary College, Chennai (Kirubaharan *et al*. 2000). This was followed by administration of LaSota booster via drinking water to 12 out of 24 primed poults in each group at 6 weeks of age.

Thus, in each group, 12 poults received both primary and booster vaccines, 12 poults received only primary vaccine and remaining 12 poults served as unvaccinated internal control. From first week of age onwards, antibody levels were estimated at weekly intervals by haemagglutination inhibition (HI) test (Boney *et al*. 1975) up to the termination of studies by 12th week of age. HI test was performed according to OIE Manual (OIE 2004). The complete vaccination trial is illustrated in Fig. 1.

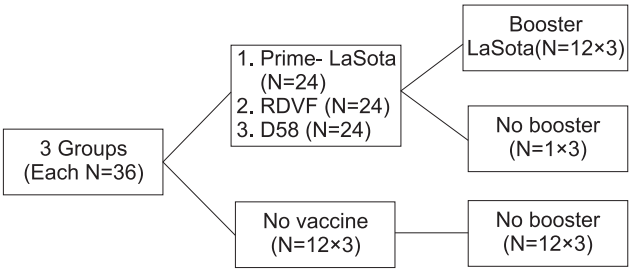

Fig. 1. Vaccination trial plan.

RESULTS AND DISCUSSION

Maternal antibody titre at first week of age in each group was measured from pooled sera samples. From second week onwards, HI titre was estimated on individual serum samples. The mean $\log_{10}$HI titre of each group, measured at weekly intervals is presented in Tables 1, 2.

Primary humoral immune response: The $\log_{10}$HI titre at first week of age, among all groups ranged from 0.903 to 1.204. This declined to a range of 0.35 to 0.93 by second week. In unvaccinated internal control groups, the maternal antibody titre persisted up to 3 to 4 weeks. Thus the life duration of maternal antibody titre could not extend beyond 1 month. The $\log_{10}$HI titre at first week of age, among all groups ranged from 0.903 to 1.204. This declined to a range of 0.35 to 0.93 by second week suggesting a maternal antibody half life of about 1 week. In unvaccinated internal control groups, the maternal antibody titre persisted up to 3 to 4 weeks. Thus the life duration of maternal antibody titre could not extend beyond 1 month. These high maternal antibodies could be attributed to the fact that the parents of these experimental poults were a vaccinated flock. A decline in the antibody titre could be attributed to these maternal antibodies due to their neutralising effect on the vaccine virus as observed by Msoffe *et al*. (2006).

Following primary vaccination at 2 weeks of age, with RDVF, LaSota and D58 vaccines, a higher HI titre was elicited by D58 group at 1 week post vaccination (third week of age), however this rise in HI titre did not have a prolonged effect as observed in RDVF and Lasota vaccinated groups. Although RDVF and Lasota vaccinated groups elicited a higher HI titre only by 2 weeks after primary vaccination (fourth week of age), the Hi titre tended to prolong beyond what was observed with F58. Since the maternal antibody titres vanished by second week, protection beyond second week requires immediate humoral response, otherwise there could be a susceptibility window in the immunity level. RDVF and LaSota both elicited significant titres only by second week post vaccination, necessitating vaccine administration by first week. D58 due to its early

Table 1. Comparative weekly humoral immune response- HI titre in different primary vaccine groups

(n=12)

Primary vaccine	Age in weeks				
	1	2	3	4	5
P:RDVFB:Nil	1.20±0.0	0.93±0.02	0.45±0.04	0.73.±0.04	1.0±0.04
P:LaSotaB: Nil	0.90±0.0	0.35±0.03	0.30±0.04	0.45±0.04	0.73±0.04
P:D58B:Nil	0.90±0.0	0.50±0.04	0.63±0.05	0.88±0.04	0.68±0.03
RDVF control	1.20±0.0	0.90±0.03	0.42±0.04	0.30±0.04	< 0.3±0.0
LaSota control	0.90±0.0	0.40±0.04	0.30±0.04	< 0.3±0.0	< 0.3±0.0
D58 control	0.90±0.0	0.45±0.04	0.30±0.04	0.30±0.0	0.3±0.0

Table 2. Comparative weekly humoral immune response- HI titre in different booster vaccine groups

(N= 12)

Booster vaccine	Booster vaccination schedule						
	Age in weeks						
	6	7	8	9	10	11	12
P:RDVF, B:LaSota	0.50±0.04	0.30±0.04	0.68±0.03	0.98±0.03	1.3±0.03	1.58±0.03	1.88±0.03
P:LaSotaB:LaSota	0.41±0.05	0.33±0.05	0.80±0.04	1.10±0.04	1.43±0.03	1.83±0.04	2.0±0.04
P:D58,B:LaSota	0.37±0.05	0.95±0.05	1.30±0.04	1.56±0.05	1.86±0.03	2.0±0.04	1.81±0.05
Control P:RDVFB:Nil	0.45±0.07	0.30±00.4	0.3±0.0	0.3±0.0	0.3±0.0	0.3±0.0	0.3±0.0
Control P:LaSotaB: Nil	0.38±0.06	0.30±0.03	< 0.3±0.0	< 0.3±0.0	< 0.3±0.0	< 0.3±0.0	< 0.3±0.0
Control P:D58B:Nil	0.36±0.05	0.30±0.04	< 0.3±0.0	< 0.3±0.0	< 0.3±0.0	< 0.3±0.0	< 0.3±0.0

P, Primary; B, booster.

immune induction could be administered by second week. Efficient antigen processing and presentation to helper T lymphocytes is very important for early induction of B lymphocyte mediated humoral immune response. The early rise in HI titre observed in D 58 group following primary vaccination perhaps due to efficient antigen presentation to immune competent cells of turkey. However, the highest titres observed in all the groups were not significantly different. Since, there was no significant difference, it could be concluded that lentogenic vaccines have comparable humoral immunogenic potential in turkeys when used as primary vaccines. Allan *et al*. (1978) proposed a protective $\log_{10}$HI titre of 1.204 against ND in chickens. Thus, the HI titres declined significantly below this protective level during second to 4/5th week, which resulted in a disease susceptibility window. This warrants advancement of primary vaccine schedule probably to first week of age to elicit reasonable protective titre as early as possible. Based on the results of the study, D 58 could be a potential primary vaccine candidate. However, upon early primary vaccination, the possibility of neutralisation of vaccine virus by higher level of maternal antibodies remains to be seen.

Anamnestic humoral immune response: When the booster was administered at sixth week of age, a strong anamnestic response was observed in all vaccinated groups, also the titre was found above the protective titre level till 12 weeks of age. The role of such anamnestic response in protecting birds in turkeys has been established (Boney *et al*. 1975).

Following LaSota booster at 6 weeks of age, the anamnestic response in D 58 primed group by first week post booster vaccination indicated that D 58 might also be more efficient in establishing immunological memory.

The effect of priming was obvious with steady increase in HI titres in all the primed groups from second or third week post booster vaccination onwards. There was waning of primary antibodies in poults which were not primed. The highest $\log_{10}$HI titre observed following booster vaccination in F, LaSota and D 58 primed groups were 1.88, 2 and 2 respectively and they did not differ significantly. Thus F, LaSota and D 58 were found to be equal in priming potential. However, the early induction of both primary and anamnestic immune response in D 58 primed group indicated the potential use of D 58 to achieve early immune response. It would be interesting to investigate the use of D 58 both as primary and booster vaccine. It should be noted that there was a second susceptibility window from fifth to seventh or eight week due to short lived primary immune response. Considering this, it would be wise to advance the booster vaccine to 3 weeks interval instead of 4 after priming. After the waning of maternal antibodies, no evidence of HI titre was detected in sera of unvaccinated control groups. This confirmed that there was no vaccine virus spread to unvaccinated poults as there was no evidence of induction of HI titres.

The effect of priming was obvious with steady increase in HI titres in all the primed groups from second or third week post booster vaccination onwards. There was waning of primary antibodies in poults which were not primed. The highest $\log_{10}$HI titre observed following booster vaccination in F, LaSota and D 58 primed groups were 1.88, 2 and 2 respectively and they did not differ significantly. Thus F, LaSota and D 58 were found to be equal in priming potential. However, the early induction of both primary and anamnestic immune response in D 58 primed group indicated the potential use of D 58 to achieve early immune response. It would be interesting to investigate the use of D 58 both as primary and booster vaccine. It should be noted that there was a second susceptibility window from fifth to seventh or eighth week due to short lived primary immune response. Considering this, it would be wise to advance the booster vaccine to 3 weeks interval instead of 4 after priming. After the waning of maternal antibodies, no evidence of HI titre was detected in sera of unvaccinated control groups. This confirmed that there was no vaccine virus spread to unvaccinated poults as there was no evidence of induction of HI titres.

Overall the 3 vaccination regimens have comparable humoral immunogenic potential. The study results suggested that primary and booster vaccination have to be advanced to first and third week of age respectively. The study reiterated the necessity of booster vaccination to maintain sustained levels of protective titres until turkeys are marketed.

REFERENCES

Allan W H, Lancaster J E and Toth B. 1978. Newcastle disease vaccines- Their production and use. *FAO Animal Production and Health Series* No.10 FAO, Rome, Italy.

Balachandran C, Jayanthi N, Krithiga K and Selvaraj J. 2007. An outbreak of Newcastle disease and Fowl cholera in adult turkey farm. *International workshop on 'Capacity building in the areas of avian viral diseases and animal biotechnological applications'*. Madras Veterinary College, Chennai, India. pp 25–27.

Boney W A Jr, Stone H D, Gillette, K G and Coria M F. 1975. Viscerotropic velogenic Newcastle disease in turkeys: immune response following vaccination with either viable B1 strain or inactivated vaccine. *Avian Diseases* **19**: 19–30.

Ghumman J S, Wiggins A D and Bankowski R A. 1976. Antibody Response and Resistance of Turkeys to Newcastle Disease Vaccine Strain LaSota. *Avian Diseases* **20**: 1–8.

Kelleher C J, Halvorson D A and Newman J A. 1988. Efficacy of viable and inactivated Newcastle disease virus vaccines in turkeys. *Avian Diseases* **32**: 342–46.

Kirubaharan J J, Vel Murugan R, Kumanan K and Albert A. 2000. Inactivated vaccines against Newcastle disease virus. 2 Humoral immune response. *Indian Veterinary Journal* **77**: 563.

Kumanan K, Gandhi A A, Vijayarani K and Nainar A M. 2004. Pathotyping of a Newcastle disease virus isolated from turkeys. *Indian Jounal of Animal Sciences* **74**: 848–50.

Msoffe P L M, Minga U M, Mitambo M M A and Gwakisa P S. 2006. Disparate HI titre dynamics following Newcastle disease vaccination to six local chicken ecotypes of Tanzania. *Livestock Research and Rural Development* **18**: 1–3.

Office International des Epizooties. 2004. *Terrestrial manual of diagnostic tests and vaccines for terrestrial animals (mammals,birds and bees).* 5th edn.