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Review Article

### Evolution of Newcastle disease virus in Egypt.

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#### ABSTRACT

In Egypt, Newcastle disease virus (NDV) outbreaks are occurring frequently, researchers try to study epidemiology of the virulent NDV isolates from these outbreaks. Velogenic & mild NDV strains was successfully isolated in Egypt from 1950 till now. NDV still reported to cause severe outbreaks with high losses in infected flocks during 2005, velogenic NDV caused outbreaks among commercial chicken in Egypt so, it is obligatory to study the protective immunity of commercially available vaccines for prevention and control of the disease. VIIb NDV genotype was previously described as the predominant sub-genotype of genotype VII circulating with severe outbreaks in Egypt in last decade.

#### INTRODUCTION

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Newcastle disease (ND) is one of the most devastating viral diseases of poultry and has great economic impact in the poultry industry causing bird mortality reaches 100% between the infected flocks (Alexander et al. 2003). Newcastle disease, caused by Newcastle Virus, is a serious illness of birds, particularly chicken and turkey and has been one of the major causes of economic losses in the poultry industry (Alexander 1988). NDV is an enveloped, single stranded, nonsegmented RNA of negative sense virus. NDV is the only member of the genus Avulavirus, subfamily Paramyxovir-

inae that belonged to family Paramyxoviridae in the order Mononegavirales and is designated avian paramyxovirus-1 (APMV-1) (Murphy et al., 1995; Mayo, 2002). Ten serogroups of avian paramyxoviruses have been recognized: APMV-1 to APMV-10 (OIE, 2012). Of these, APMV-1 remains the most important pathogen for poultry (Alexander et al. 2003). Newcastle disease virus is regarded as being endemic in many countries including Egypt (OIE, 2009; OIE 2012). Exotic Newcastle Disease Virus (ENDV) is very virulent strain causes severe losses in pet and game birds in USA and these birds are considered a good reservoir for transmitting the virus between

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domestic commercial flocks causing severe losses in poultry production (OIE, 2008). Infection by NDV is categorized into different pathotypes according to the strain affecting the flock and clinical signs appear; lentogenic strains which cause mild respiratory symptoms and used as secondary live vaccines, mesogenic strains which are fatal only for young chicks, viscerotropic velogenic strains which are fatal for all ages of chicken and almost characterized with enteric signs and neurotropic velogenic strains which are characterized with nervous signs (Alexander and Allan, 1974; Beard et al. 1984).

The viral genome consists of 15,186 nucleotides (Deleuw and Peeters et al. 1999) and contains six genes encoding six major polypeptides: nucleoprotein (NP), phosphoprotein (P), matrix protein (M), fusion (F) protein, haemagglutinin neuraminidase (HN) and large RNA dependent RNA polymerase protein (L), HN, M, F proteins which are related to viral envelope and three proteins NP, P, L are related to viral genomic RNA (Millar, 2009). Fusion protein plays very important role in NDV virulence and pathogenicity to induce and promote the fusion between virus and target cell membranes (Lamb and Kolakofsky, 1996). It is synthesized as a fusion inactive precursor (F0) and must be proteolytically cleaved into F1 and F2 polypeptides by host proteases to become fusion active protein (Morison et al. 1993). There are 10 genotypes of Newcastle disease virus isolates based on differences on fusion protein gene (Huang et al. 2004). Recently, (NDV) separated into 15 genotypes, class I viruses comprise a single genotype, while class II contains 15 genetic groups including 10 previously established (I–IX, and XI) and five new genotypes (X, XII, XIII, XIV and XV). Sub genotypes were identified among class I and class II genotypes (Diel et al. 2012).

### History of ND in Egypt

In Egypt, NDV outbreaks are occurring frequently, some researchers try to study epidemiology of the virulent NDV isolates from these outbreaks. Newcastle disease is well documented in Egypt in year 1942 (Daubney and Mancy, 1948). Since that date the recognition

of velogenic NDV was successfully carried out by El-Nassari, (1957); Eissa, (1960); Lancaster and Alexander, (1975) while Ahmed et al. (1966) record the first occurrence of mild NDV in Egypt. Severe outbreaks of NDV have occurred in Upper Egypt in 1950 with high mortalities in chicken (El-Nassari et al. 1960). The Pathogenicity of NDV in other species was reported in pigeon (Ahmed and Reda, 1967) and free flying birds (Moussa et al., 1988). NDV was isolated and identified using HI and AGPT were carried out periodically by many authors (Ahmed et al. 1965; Ismail et al. 1981, Bekhet and Abdel hamid, 1990). The genetic resistance of the Egyptian native breeds was reported by Hassan et al. (2004). Determination of virulence using gene analysis was carried out for local velogenic isolate SR/76 by Hussein et al. (2005). NDV still reported to cause severe outbreaks with high losses in infected flocks during 2005, velogenic NDV caused outbreaks among commercial chicken in Egypt these outbreaks raised concerns regarding the protective immunity of commercially available vaccines for prevention and control of the virus in poultry (Abdel moneim et al. 2006; Amer et al. 2006). The phylogenetic analysis showed Egyptian NDV isolates are closely related with the genotype II of class II NDV strains. So, sequences of the F genes of 2006 Egypt isolates are closely related to that of the 2005 suggesting that these strains are probably circulating in the vaccinated bird population in Egypt until development of an outbreak (Mohamed et al. 2011).

Phylogenetic analysis showed that NDV strains isolated in Egypt are closely related with the NDV strains isolated in China after complete genome sequence (Mahmoud et al. 2009). Investigation of 9 isolates of Newcastle disease virus (NDV) recovered from 386 cloacal swabs from birds migrating to Egypt revealed differences among isolates from various or even the same species of birds. Pathogenicity tests in susceptible chicken and pigeon by different routes of application suggested the categorization of all isolates as velogenic strains of NDV, whereby 7 isolates exhibited marked viscerotropic characters for chicken may prove that the migratory birds are main

source of NDV infection in Egypt (**Ahmed et al. 2010**). **Hussein et al. (2012)** they record that mixed infection with IBV and NDV circulating among broiler flocks demonstrating high mortality which reached more than 60% in some flocks, Increased mortalities might be related to the occurrence of mixed infection by both viruses. NDV genotype VII was isolated from H5N1 infected broiler flock 2012, this isolate was in close range to Chinese strains so this study reports the characterization of Newcastle Disease Virus genotype VII in broiler chicken co-infected with Avian influenza H5N1 virus (**Hussein et al. 2014**). Isolation and characterization of Newcastle disease virus (NDV) from recent outbreaks affecting poultry farms in Egypt between 2011 and 2012, clinically infected NDV vaccinated broiler farms in Fayoum, Behira and Giza Provinces. velogenic genotype isolate clustered and published class II genotype VII sub genotype d NDVs and closely related to Middle East isolates, and concluded that spread of velogenic genotype strain to Egypt via Middle Eastern countries is likely to be the source of infection (**Radwan et al. 2013**).

Phylogenetic analysis of genotype VII revealed that all the virulent viruses belonged to genotype VIIb, according to the unified nomenclature and classification system of NDV proposed by **Diel et al. (2012)**. Also, VIIb was previously described as the predominant sub-genotype of genotype VII circulating with severe outbreaks in Egypt (**Saad et al. 2017 & 2021; Selim et al. 2018; Zanaty et al. 2019**).

## CONCLUSION

**T**he causative agent of recent ND outbreaks in vaccinated broiler flocks from Egypt was found to belong to velogenic genotype VIIb. This strain was genetically close to other Egyptian genotype VII isolates obtained during the last decade with high pathotypic features (**Radwan et al. 2013 Saad et al. 2017 & 2021 Selim et al. 2018 Zanaty et al. 2019**).

Results of the in vivo study revealed that adequate heterologous antibody levels, in-

duced by the proposed vaccination program, sufficiently protected birds from morbidity and mortality. However, virus shedding was quantitatively affected in relation to the time of challenge after vaccination. Altogether, with an absence of vaccines able to induce homologous antibody to the presently circulating viruses, higher antibody levels, which depend on efficient and timely implementation of the vaccination program, are considered as highly important in relation to the reduction of virus shedding (**Saad et al. 2017**).

## REFERENCES

- Abdelmoneim AS, Azza A. El sawah Kandil MA. 2006. Characterization of variant strain of Newcastle Disease Virus in Egypt. Beni- Suef veterinary medical journal (BS.vet. J.2006.vol.16, no.1, p.12-17).
- Ahmed AAS, Sokkar IMH, ElSisi MA. 1965. Studies on Newcastle disease virus with the aid of agar gel precipitation test. J.vet.Sci.U.A.R:2(2):135-146.
- Ahmed AAS, Abbasi KH, Reda, IM. 1966. The distribution of the F vaccine strain of Newcastle disease in intra-ocularly vaccinated chickens. Arab. vet. Med. Ass. J. 26 (3&4):221-228.
- Ahmed AAS, Abbasi KH, Reda, IM. 1967. Response of pigeons to eight strains of Newcastle virus. Avian Diseases, Vol. 11, No. (4): pp. 734-740.
- Ahmed AAS, MS, Sabban AMM, Ibrahim A, Amin AR, Khafagi Sheble. 2010. Some Properties of Newcastle Disease Virus Isolates Recovered from Migratory Birds to Egypt. Volume 27, Issue 4, pages 313 – 319, May 2010.
- Alexander DJ, Allan WH. 1974. Newcastle disease virus Pathotypes. Avian Pathol. (3):269–268.
- Alexander DJ, Pattison M, Macpherson I. 1983. Avian paramyxovirus of PMV-3 serotype in British turkeys. Avian Pathol., (12):469- 482.
- Alexander DJ. 1988. Newcastle disease diagnosis, p. 147–160. In D. J. Alexander (ed.), Newcastle disease. Kluwer Academic Publishers, Boston, Mass.

- Amer MM, Wafaa A, Abd El-Ghany. 2006. The effect of different Newcastle disease live vaccines and vaccination schedules on the immune response and performance of broiler chickens serologically positive to Mycoplasma .BS. Vet. Med. J. vol. 16, no.1, p.18-26.
- Beard CW, Hanson RP, Hofstad MS, Barnes HJ, Calnek B, Reid WM, Yoder HW (eds.). 1984. Newcastle Disease. In Diseases of Poultry, 8th ed. Iowa State University Press: Ames, IA, 452-470.
- Bekhet AB, Abd el-hamid HS. 1990. Characterization of Newcastle disease virus isolated from field outbreaks. proc. 2<sup>nd</sup> scientific conf. of the Egyptian vet.poult.Ass.Pp:38-49.
- Daubney R, Mancy W. 1948. The occurrence of Newcastle disease in Egypt. J. comp. pathology (58):189-196.
- De Leeuw O, B, Peeters. 1999. Complete nucleotide sequence of Newcastle disease virus: evidence for the existence of a new genus within the subfamily Paramyxovirinae. J. Gen. Virol. (80):131-136.
- Diel DG, da Silva LHA, Liu H, Wang Z, Miller PJ. 2012. Genetic diversity of avian paramyxovirus type 1: Proposal for a unified nomenclature and classification system of Newcastle disease virus genotypes. Infect Genet Evol (12): 1770-1779.
- Eissa YM. 1960. Poultry diseases in southern region of U.A.R.Pros.1<sup>st</sup> ann.: vet.cong. Egypt, vet.Med.Ass.Pp.19.
- El-Nassari B, Bayoumy 1957. Newcastle disease in Egypt. Ministry of Agriculture, veterinary laboratories and research administration bull no.279, 40.
- El-Nassari. B. Bayoumy Josephine K, Eskarous,1960. The distribution of fowl plague and Newcastle disease in Upper Egypt, archive of microbiology journal, vol. 36,no.2,p147-150.
- Hassan MK, Afifi MM, Ali M.M 2004. Genetic resistance of Egyptian chicken to infectious bursal disease and Newcastle diseases viruses. Tropical animal health production, 36(1):111-119.
- Huang YHQ, Wan HQ, Liu YT, Wu, XF, Liu. 2004. Genomic sequence of an isolate of Newcastle disease virus isolated from an outbreak in geese: a novel six nucleotide insertion in the noncoding region of the nucleoprotein gene. Archive of virology, vol., 149 no.7, P,1445-1457.
- Hussein HA, El-Sanousi AA, Youssif AA, Shalaby Saber MS, Reda IM. 2005. Sequence analysis of fusion and matrix protein genes of the Velogenic viscerotropic Newcastle disease virus. International J. of virology, 2005(1) (1): 38.
- Hussein HA, Arafa A, Rohaim Mohammed 2012. Sequence analysis of Infectious bronchitis Virus (IBV) IS/1494 like coinfecting with Newcastle disease virus (NDV) in broiler chickens with high mortalities in Egypt 2012. World Veterinary Poultry Association French branch (GF-AMVA) XVIII WVPA 2013.
- Hussein HA, Emara MM, Rohaim MA. 2014. Molecular Characterization of Newcastle Disease Virus Genotype VIID in Avian influenza H5N1 Infected Broiler Flock in Egypt. International Journal of Virology; 2014, Vol. 10 Issue 1, p46.
- Ismail A, Elsabbagh A, Eltaher AM, Hassan NM, Ibrahim k, Ibrahim SN, Barhoum N. 1981. Immune response to KND vaccination in chicken .zagazig university .J.,(3):67-76.
- Lamb RA, D, Kolakofsky. 1996. Paramyxoviridae: the viruses and their replication, p. 557-604. In B. N. Fields virology, D. M. Knipe, and P. M. Howley (ed.), Fundamental virology. Lippincott-Raven, Philadelphia, Pa.
- Lancaster J, Alexander DJ. 1975. A Newcastle disease virus and spread. A review of some of the literature. Canada Depart. Of Agri., Monograph No. 11.
- Mahmoud HA, Mohamed Sachin Kumar Anandan paldurai Mohamed M, Megahed Ibrahim A, Ghanem Mohamed A, LebDAH Siba k, samal. 2009. Complete genome sequence of avirulent Newcastle disease virus isolated from an outbreak in chickens in Egypt. Virus genes (2009) (39):234- 237.
- Mayo MA. 2002. A summary of taxonomic changes recently approved by ICTV. Archive virol.,147 (8):1070-1076.

- Miller PJ, LM, Kim CL, Afonso 2009. Evolutionary dynamics of Newcastle disease virus. *virology*.(391):64-72.
- Mohamed Mahmoud HA, Kumar Sachin Pal-durai Samal Siba K, Anandan. 2011. Sequence analysis of fusion protein gene of Newcastle disease virus isolated from outbreaks in Egypt during 2006. *Virology Journal* 2011, 8:237.
- Morrison TC, McQuain T, Sergel L, McGinnes J, Reitter. 1993. The role of the amino terminus F1 of the Newcastle disease virus fusion protein in cleavage and fusion. *Virology*, (193):997–1000.
- Moussa S, Soliman A, Bayoumi AH, Sokkar IH, 1988. The role played by free living birds in transmission of Newcastle disease virus. *Assuit vet. Medical .J*.20 (39):179-184.
- Murphy FA, CM, Fauquet DHL, Bishop SA, Ghabrial AW, Jarvis GP, Martelli MA, Mayo MD, Summers. 1995. Virus taxonomy: classification and nomenclature of viruses. Sixth report of the International Committee on Taxonomy of Viruses. Academic Press, San Diego, Calif.1995.
- OIE 2008. Avian Paramyxovirus-1 Infection, Goose Paramyxovirus Infection .July 14, 2008 .The center for food security and public health, Iowa state university ,college of veterinary medicine , Ames , Iowa,50011.
- OIE 2009. Newcastle disease, chapter 2.3.14, volume (1) section (2-3).page: 576-589.
- OIE 2012. Newcastle disease, chapter 2.3.14.
- Radwan MM, El-Sanousi AA, Darwish SF, Shalaby. M. A., El- Sabagh. IM. 2013. Isolation and molecular characterization of Newcastle disease virus genotypes II and VIIId in Egypt between 2011 and 2012. *Virus Genes* (2013) 47:311–316.
- Saad AMA, Samy MA, Soliman A, Arafa A, Zanaty MK, Hassan AH, Sultan AI, Bazid AH, Hussein. 2017. Genotypic and pathogenic characterization of genotype VII Newcastle disease viruses isolated from commercial farms in Egypt and evaluation of heterologous antibody responses. *Arch. Virol. Jul. 1; 162(7): 1985-94.* <https://doi.org/10.1007/s00705-017-3336-y>.
- Saad A Moussa Mohammed Ahmed Mahmoud Abdullah Mahmoud Saied Mustafa Saleh Mohamed A, Soliman and Ali Mahmoud Zanaty. 2021. Genotyping of Recent Virulent Newcastle Disease Virus Strains Isolated from Menofia Governorate, Egypt. *Hosts Viruses* 8(1): 1-6.
- Selim KM, A, Selim A, Arafa HA, Hussein AA, Elsanousi. 2018. Molecular characterization of full fusion protein (F) of Newcastle disease virus genotype VIIId isolated from Egypt during 2012-2016. *Vet. World.* 11(7): 930. <https://doi.org/10.14202/vetworld.2018.930-938>.
- Zanaty AM, NM, Hagag N, Rabie M, Saied K, Selim SA, Moussa AG, Shalaby AS, Arafa and M.K. Hassan. 2019. Epidemiological, phylogenetic analysis and pathogenicity of Newcastle disease virus circulating in poultry farms, Egypt during 2015-2018. *Hosts Viruses* 6(3): 50-59.