The Bird Flu: Avian Influenza Virus: A Threat To Human Health

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ABSTRACT- Bird flu is an infection caused by avian influenza viruses, which are of different types A, B and C. Type A avian influenza viruses are the most frequently associated with avian influenza epidemics and pandemics. There are 16 hemagglutinin (H1 to H16) and 9 neuraminidase types (N1 to N9) identified till date. A peculiar characteristic of influenza A viruses is their propensity for genetic change by two main processes: antigenic drift (small, gradual changes) and antigenic shift (abrupt, major change producing a novel influenza A virus subtype).There are various modes of transmission of human influenza including inhalation, direct or indirect (fomite) contact etc., can have manifestations ranging from mild to severe or fatal disease, depend on the viral subtype causing the disease. Avian influenza A (H5N1) results in high death rate amongst infants and young children. The first outbreak of human infection by avian influenza viruses (H5N1) was observed in 1997 in Hong Kong. Since then a large number of outbreaks have been reported in different parts of the world. In fact, the spread of avian influenza H5N1 in various species including humans has lead to a current pandemic threat. Human avian influenza infections in persons at high risk of exposure can be prevented by adopting a series of protective measures, anti-viral vaccination and health monitoring. Drugs currently available for the treatment or prophylaxis of influenza infections include the adamantanes (amantadine and rimantadine) and the newer class of neuraminidase inhibitors (zanamivir, oseltamivir and peramivir). However, vaccines are considered the first line of defense for reducing the e Influenza virus belongs to a family of viruses called orthomyxoviridae, a group of single stranded minus-sense RNA viruses with a segmented genome. The eight RNA segments of the influenza A virus genome encode 11 viral proteins. These include the polymerase proteins (PB1, PB2, PA, PB1-F2), nucleocapsid protein, hemagglutinin, neuraminidase, matrix proteins (M1, M2), and nonstructural proteins (NS1, NS2).

KEYWORDS: Bird Flu, Avian Influenza, Hemagglutinin, Neuraminidase

INTRODUCTION - Avian influenza (bird flu), an infection caused by avian influenza viruses has emerged as the primary public health concern of the 21st century. There are three types of influenza viruses, designated A, B and C. Variants of this species are sometimes named according to the species the strain

is endemic in or adapted to for example, human flu, swine flu, horse Flu, dog flu etc. Hemagglutinin and neuraminidase[1] are the major antigenic determinants of influenza A viruses and serve as the basis for their subtype classification. There are 16 hemagglutinin (H1 to H16) and 9 neuraminidase types (N1 to N9).Hemagglutinin mediates attachment to and entry of the virus into host cells by binding to sialic acid receptors at the cell surface, which partly accounts for the host specificity of the various influenza A virus subtypes. However, a change of one amino acid of the H5 protein is sufficient to change the receptor binding specificity of A/H5N1 viruses[2]. Thus, the barrier to interspecies infection can be overcome easily. Hemagglutinin also forms the main viral target of protective humoral immunity by neutralizing antibody. Neuraminidase facilitates the spread of the virions in the host by cleaving the glycosidic linkages to sialic acid on host cells and the surface of the viral particles and is the target of neuraminidase inhibitors. M2 is an ion channel crucial for the pH-dependent dissociation of matrix proteins from the nucleocapsid during viral uncoating and pH changes across the trans-Golgi network during maturation of hemagglutinin molecules. M2 is the target of the adamantanes (amantadine and rimantadine). Mutation in the M2 from serine to asparagine at residue 31 invariably confers resistance to adamantanes.PB1-F2 causes cellular apoptosis by acting on the host mitochondria. The hemagglutinin and PB2 proteins appear to be important in determining host specificity and virulence[3]. excess morbidity and mortality that invariably accompany pandemics and a number of clinical trials are under way to test them.

TYPES OF BIRD FLU VIRUSES INFECTING BIRDS AND HUMANS

Influenza A H5[4-5]: Nine potential subtypes of H5 are known. H5 infections, such as HPAI H5N1 viruses currently circulating in Asia[6] and Europe, have been documented among humans and sometimes cause severe illness or death. Influenza A H7: Nine potential subtypes of H7 are known. H7 infection in humans is rare but can occur among persons who have direct contact with infected birds. Symptoms may include conjunctivitis and/or upper respiratory symptoms[7]. H7 viruses have been associated with both LPAI (e.g., H7N2, H7N7) and HPAI (e.g., H7N3, H7N7), and have caused mild to severe and fatal illness in humans.

Influenza A H9 Nine potential subtypes of H9 are known; influenza A H9 has rarely been reported to infect humans. However, this subtype has been documented only in a low pathogenic form. Influenza Type B These are usually found only in humans. Unlike influenza A viruses, these viruses are not classified according to subtype. Influenza B viruses can cause morbidity and mortality among humans, but in general are associated with less severe epidemics than

influenza A viruses. Although influenza type B viruses can cause human epidemics, they have not caused pandemics. Influenza Type C viruses cause mild illness in humans and do not cause epidemics or pandemics. These viruses are not classified according to subtype.

Low vs Highly pathogenic avian influenza viruses[8]

On the basis of specific m The current spread of avian influenza H5N1 in domestic poultry flocks[9] and wild birds across the world, as well as the demonstrated ability of this virus to cross the species barrier and infect humans, has lead to a high level of concern that a pandemic may develop. For a pandemic to arise, three pre-requisites have been identified: a new virus subtype to which the population has little or no immunity must emerge; the new virus must be able to replicate in humans and cause serious illness; and the new virus must be efficiently transmitted from one human to another[10].Unlike most pandemics, which emerge randomly, H5N1[11] has been recognized as a likely pandemic candidate for almost 10 years. molecular genetic and pathogenesis criteria that require specific testing, influenza virus A are classified into low pathogenic (LPAIA) and high pathogenic (HPAIA) viruses. However, low pathogenic can evolve into high pathogenic viruses. H5, H7- H5N1, H7N7, H7N3 are HPAIA viruses and human infections with these viruses have ranged from mild (H7N3, H7N7) to severe and fatal disease (H7N7, H5N1). LPAIA viruses causing infection in humans include H7N7, H9N2,[12] H7N2.

A constantly mutating virus: notable feature of influenza A viruses is their propensity for genetic change, which occurs by two main processes: antigenic drift and antigenic shift. Antigenic drift refers to small, gradual changes that occur through point mutations in the two genes that contain the genetic material to produce the main surface proteins, hemagglutinin, and neuraminidase. These point mutations occur unpredictably and result in minor changes to these surface proteins. Antigenic shift refers to an abrupt, major change to produce a novel influenza A virus subtype in humans that was not currently circulating among people. It can occur either through direct animal (poultry)-to-human transmission [13]or through mixing of human influenza A and animal influenza A virus genes to create a new human influenza A subtype virus through a process called genetic reassortment[7].

PROTECTIVE MEASURES- Protection of persons at risk of occupational exposure with the help of personal protective equipment like protective clothing, heavy-duty rubber work gloves, standard well-fitted surgical masks, goggles, rubber or polyurethane boots. Pharmaceutical prophylaxis and treatment. Antivirals should be readily available for the treatment of suspected and

confirmed cases. Vaccination for public health purposes. Health authorities may consider vaccination against seasonal influenza for persons at risk of occupational exposure to the H5N1 virus. Vaccination against seasonal influenza will not protect people against infection with the H5N1 virus; no vaccine against H5N1 is presently available. Health monitoring. Those at risk of occupational exposure should be aware of the early clinical signs of H5N1 infection, check for these signs (especially fever) each day during potential exposure and for 14 days after last exposure and communicate any symptoms to a designated local physician. Suspected cases should be placed in isolation and managed according to recommended procedures for infection control. Drug therapy for bird flu Two groups of drugs are currently available for the treatment or prophylaxis of influenza infections: the adamantanes and the newer class of neuraminidase inhibitors. The adamantanes (amantadine and rimantadine) interfere with viral uncoating inside the cell. They are effective only against influenza A and are associated with several toxic effects and with rapid emergence of drug-resistant variants. Adamantane-resistant isolates of influenza A are genetically stable, can be transmitted to susceptible contacts, are as pathogenic as wild-type virus isolates, and can be shed for prolonged periods in immunocompromised patients taking the drug. This potential for the development of resistance especially limits the use of the adamantanes for the treatment of influenza, although the drugs still have a place in planning for prophylaxis during an epidemic. The neuraminidase inhibitors (zanamivir and oseltamivir) interfere with the release of progeny influenza virus from infected host cells, a process that prevents infection of new host cells and thereby halts the spread of infection in the respiratory tract. These have activity against both influenza A and B viruses. A key advantage of the neuraminidase inhibitors, and a major difference from the adamantanes, is that development of resistance is very rare.

CONCLUSION – Bird flu is an infection caused by the avian influenza virus which had it's first outbreak in 1997 in Hongkong. Since then a large number of outbreaks are reported across the world. In fact, the spread of avian influenza H5N1 in various species including humans has lead to a current pandemic threat. Human avian influenza infections in persons at high risk of exposure can be prevented by adopting a series of protective measures, anti-viral vaccination and health monitoring. Drugs currently available for the treatment or prophylaxis of influenza infections include the adamantanes (amantadine and rimantadine) and the newer class of neuraminidase inhibitors (zanamivir, oseltamivir and peramivir). However, vaccines are considered the first line of defense for reducing the e Influenza virus belongs to a family of viruses called Orthomyxoviridae , Apart from the dependance and usage of drugs the

government and regulatory authorities should take other measures including the spread of awareness .

REFERENCES-

1-Moscona Anne, Neuraminidase Inhibitors for Influenza. N Engl J Med 353:1363-73 (2005).

2-Hayden, F., A .Klimov , M, Tashiro, A. Hay, A. Monto, J. Mc Kimm - Breschkin , C. Macken, A. Hampson, R.G. Webster , M. Amyard , & M. Zambon.

Neuraminidase inhibitor susceptibility network position Statement: Antiviral resistance in influenza A/H5N1 Virus . Antivir ,Ther.10:873-877 (2005).

3-Samson S Y, Wong & Kwok- Yung Yuen. Avian Influenza virus infections in Humans, 129:156-168 (2006).

4-Katz , J.M., X .Lu , T. M. Tumpey ,C. B. Smith, M.W. Shaw, & K. Subbarao . Molecular correlates of influenza AH5N1 virus pathogenesis in mice ournal Viral 74:10807 -10810 (2000).

5-L,Sims , T. Harder, I. Brown et al, "Highly pathogenic H5 Avian influenza in 2010 & 2017-observations & future perspectives", Focus on ,no-11, (2017).

6-Anonymous . Evolution of H5N1 Avian influenza viruses in Asia. Emerg. Infect. Dis.11:1515-1521 (2005).

7-Gillim-Ross, L., & K. Subbarao. "Emerging respiratory viruses: Challenges & Vaccine strategies. Clin. Microbiol. Rev. 19:614-636 (2006).

8-Juckett Gregory . Avian influenza: Preparing for a Pandemic. Am. Fam Physician 74:783-790 (2006).

9-I. Capua & D.J Alexander, "Alvina Influenza infection in birds: A challenge & Opportunity for the Poultry Veterinarian, "Poultry Sci, Vol.88(4) 842-846 (2009).

10-Durrheim David, Ferson Mark, Preparing for the inevitable-an influenza, N S W Public Health Bull. 17(7-8):97-98(2006).

11-A. Arafa, D.L. Suarez, M.K .Harsan , & M. M. Aly, "Phylo-genetic analysis of Hemagglutinin & Neuraminidase genes of highly pathogenic Avian Influenza H5N1 Avian Diseases. Vol.54, No.1, 345-349 (2010).

12-Butt, K.M., G.J. Smith, H. Chen . L.J. Zhang, Y.H. Leung , K.M. Xu, W. Lim, R.G. Webster, K.Y. Yuen, J.S. Peiris & Y. Guan "Human Infection with

an Avian H9N2 Influenza A Virus in Hongkong Journal Clin. Microbiol, 43:5760-5767(2005).

13-Vong, S., B. Coghlan, S. Mandy, D. Holl, H. Seng, S. Ly, M.J. Miller, P. Buchy , Y. Frochilch, J.B. Dufourcq , T.M. Poultry to human H5N1 virus transmission, Emerg, Infect. Dis, 12:1542-1547 (2006).s