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Prions disease and pandemic risk by H5N1 avian influenza A virus (IAV) and risk of biological weapons

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Abstract

The new gain-of-function of pathogen neurotropic H5N1 avian influenza A virus (IAV) strain named IAV/WSN /33 (H1N1) induced not only the conversion of normal cell-surface glycoprotein (PrPC) into a prion beta-structure-rich insoluble conformer (PrPSc). But also, the formation of infectious prions in cultured mouse neuroblastoma (N2aC24) cells. Thus, is plausible to use this virus as a biological weapon. So, the major infectious risk is a recombinant virus of prions which can be dispersed by aerosol, emerging as potential danger since they can be used in the development of biological weapons. Because recombinant prions are infectious either bound to soil particles or in aerosols. In addition, viruses just as prions can maintain their ability to infection, remaining in the ground for a long time. Therefore, lethal prions can be developed by malicious researchers, who could use it to attack political enemies causing diseases above suspicion.

Keywords: Virus; Prions; Biochemical Weapons; Pandemic; Pathogen neurotropic H5N1

1. Introduction

One of the advantages of use a prion disease causing by virus as pandemic it's the trade of vaccines, by malicious group, which causes the pandemic to after sells the cure [1]. Being able to vaccinate our own nation preventively and populations of friendly nations [1,2]. This is a type of warfare called fourth or fifth generation warfare [1,2,3].

Prions or virus attack can be delivered by simple objects without giving the victim any chance to receive a treatment [1]. Thus, some political enemies must be eliminated by biochemical and biological attack [2]. Prions can be a possible alternative to the use of venoms, precisely because make the investigation process very difficult to trace the assassin agent [3].

To protect an interest population, like the singular characteristics of virus that induces prion disease [1,2,3] a preventive vaccine can be first developing [1,2,3] preventively against the biological weapon. A fact that contributes to the efficiency of a vaccine is glycoprotein PrPC, which has a protective role against lethal infection of IAV/WSN infection in mouse, through the octapeptide repeat (OR) region [4,5,6]. So, theoretically the OR region is also required for viral induce conversion of PrPC into PrPSc [7].

The exact process of viral entry into the nervous system is unknown. Didactic entry process can be divided into five steps. (1) Nasal spray or oral intake of virus, (2) viral survives to digestive enzymes of the gastrointestinal tract, (3) the virus can be taken up by gut-related lymphoid tissue, such as Peyer patches. Both follicular dendritic cells and tingible body macrophages, present in germinal centers are thought to play a role in propagation of virus, in gut-associated

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lymphoid tissues (4) the virus is hypothesized to be taken up by the sympathetic or parasympathetic nervous system either directly from these lymphoid tissues or after transport to the spleen. The virus may also be transported to draining lymph nodes to more remote regions, such as the tonsils, by lymphatics. (5) Lastly virus is proposed to reach the brain by transport along the sympathetic or parasympathetic nervous system [1,3].

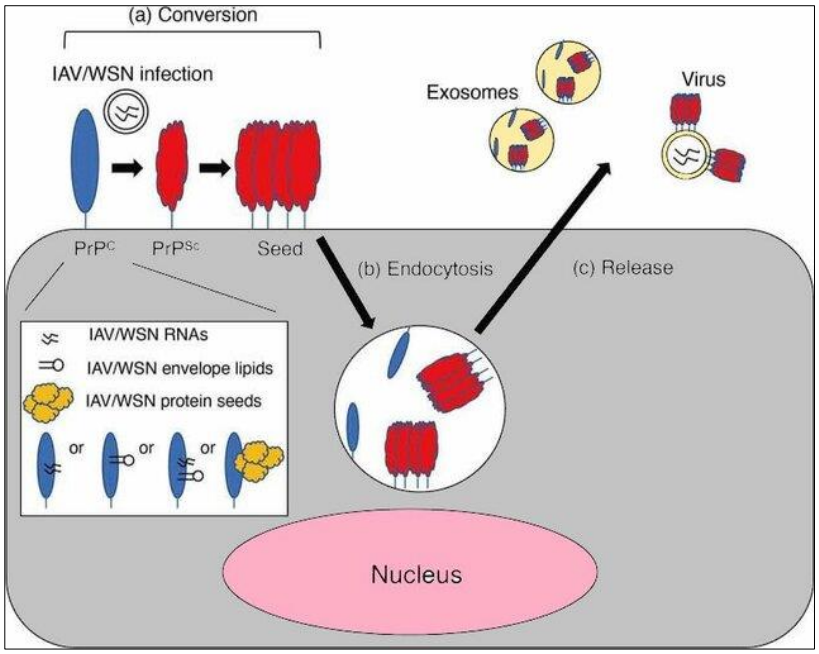

Figure 1 Virus IAV/WSN theoretical mechanism of propagation, the virus uses the innate defense system by pH dependent endosome-like organelles or lysosomes with acidic environments. So professional antigen presenting cells (APCs) like dendritic cells (DCs) are plausible locations for viral propagation of PrPSc like proteins

Thus, data indicate that prions travel through a chain reaction by peripheral axons towards cell bodies to central nervous system of cervical spine and brain [8,9,10,11].

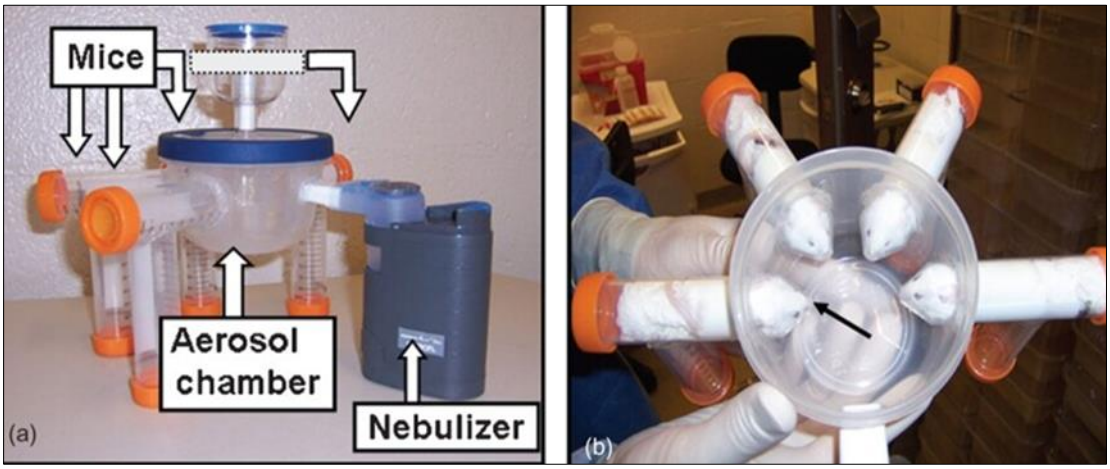

Figure 2 Prion aerosolizing. (a) Apparatus with aerosolizing chamber with nebulizer of four plastic enclosures to accommodate mice. (b) Top view of Apparatus so, the mice are inserted in place to provide nose-only exposure to the chamber (arrow). Courtesy of Journal of General Virology, Microbiology Society, London. United Kingdom

So, an obvious advantage of using a virus over a pure prion weapon, would be fact that a vaccine could protect the population of the attacking country, through opsonizing antibodies, which would prevent the virus crossing the epithelial barriers of the innate immune system [1,2,3].

Thus, experimental trials have shown that infectious recombinant prions can be dispersed by aerosol, see (Figure-2 A-B) [12,13,14].

Like this, a respiratory virus could also be dispersed by aerosol and the air [1,2,3]. We cannot underestimate the immense adaptability of viruses, as well as their ability to adapt and transfect different species [15]. Because prions are part of a fantastic universe of peptides. For example, peptides specificity can be exposed until antitumor agents [16, 17, 18, 19].

In specific viral mechanism of action is possible that IAV/WSN infection might induce the conversion of PrPC into an infectious form of PrPSc. Thereby conferring new pathogenic properties to IAV/WSN by viral specific way [6]. So, in theory the, nucleic acid molecules have been suggested to be cofactor contributing to formed viral prions properties, by specific virus proteins [20].

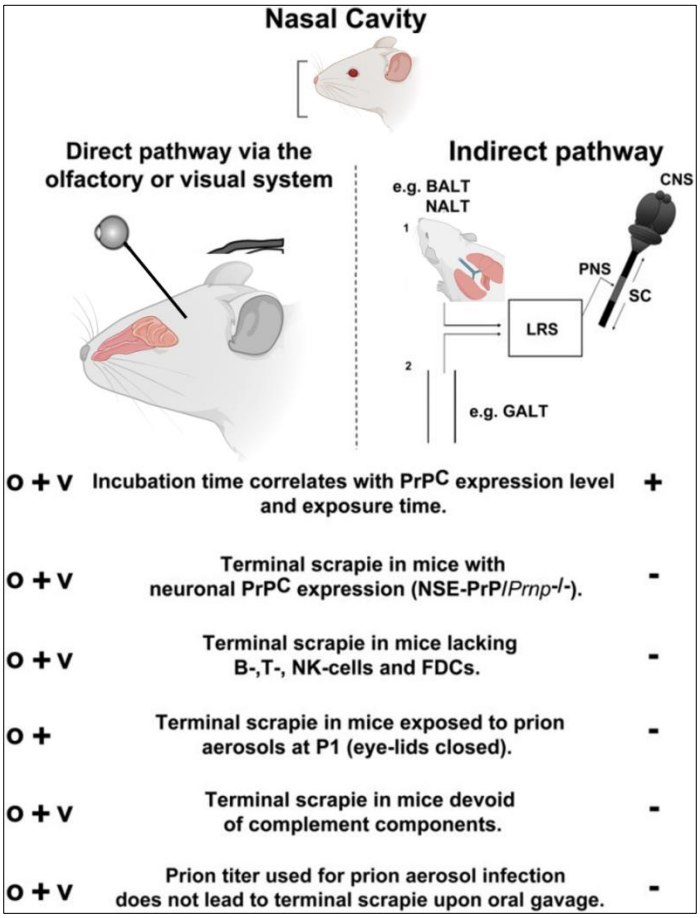

Figure 3 Model of the possible pathways of aerogenic IAV/WSN for prion transmission. O:olfactory system; V: visual system; (e.g. optic nerves); SC: spinal cord

Theoretical model of the IAV/WSN virus transmission process (Figure 3). Firstly, the virus aerosols entering the nasal cavity may directly migrate through the nasal epithelium towards olfactory nerve terminals. Subsequently, virus reach olfactory bulb neurons and colonize the limbic system and other regions of the brain. Thus, virus and its proteins that form prions may be taken up by the eyes and transported via the visual system to the central nervous system (CNS). Alternatively (right) virus may be taken up by immune cells residing in the nasal cavity, lung, or the gastrointestinal tract, from where they may be transferred to lymphoreticular system (LRS). Using for further amplification components such as bronchial lymph nodes (BALT), nasal associated lymphoid tissue (NALT), gastro intestinal lymphoid tissue (GALT), mesenteric lymph nodes, or spleen. Subsequently, prions traffic towards peripheral nerve terminals (PNS), from where they invade the central nervous system (CNS) (Figure 3) [13].

2. Discussion

We cannot underestimate the immense adaptability of viruses, as well as their ability to adapt and transfect different species [15]. Therefore, it is of utmost importance to alert the scientific community, agencies and governments around the world to discourage, inhibit and investigate those who have this evil intent [1,2,3]. Bioterrorism is a huge problem that emerging with the development of biotechnology [1,2,3]. The risk of biochemical weapons falling into the wrong hands can be devastating; could contaminate livestock, humans and many other animal species leading to thousands of deaths and would lead to a global pandemic and, moreover, the attacked country could feel entitled to retaliate with the use of weapons of mass destruction [1,2,3]. Attacks with diseases and toxic agents are records since the Peloponnesian War, Punic Wars, Opium War and Spanish Invasion of the Americas [1]. History repeats itself; these means have already been used efficiently and there is a great risk of being used again. The last generation warfare has used stealth means of attack, aiming the impossibility to identify the aggressor agent [1,3]. A country that develops new pathogens will be able to vaccinate your own population previously, through a government program, where vaccine could be administered along with others, to ensure little collateral damage in population of the aggressor country. With the intensification of conflicts, many prisoners of war could be used to test and improve the efficiency of vaccines [1,2,3]. So, the coronavirus pandemic has raised serious suspicions of a biological attack aimed deaths in the enemy population and economic damage. Finally, is easy for closed regimes to make up and manipulate numbers of deaths, and simulate that they have been affected too [1,2,3].

3. Conclusion

Warn about the risk of prions disease and pandemic contributes to society, avoiding diseases. Alerting the world's supervisory agencies and the scientific community to redouble their attention to this type of experiment.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare that there is no conflict of interest.

Consent for Publication

We authorize the full disclosure of the manuscript text and data.

References

[1] Eric Almeida Xavier. Prions and virus pathogen gain-of-function. World Journal of Advanced Research and Reviews, 2022, 15(03): 169–175.

[2] Xavier, Eric Almeida. Prions: the danger of biochemical weapons. Food Science and Technology. 2014, 34(3): 433-440.

[3] Eric Almeida Xavier. Prion/virus the danger of biological weapons. World Journal of Biology Pharmacy and Health Sciences. 2022, 10(03): 031–035.

[4] Hara H, J Chida, K Uchiyama, AD Pasiana, E Takahashi, H Kido, S Sakaguchi. Neurotropic influenza A virus infection causes prion protein misfolding into infectious prions in neuroblastoma cells. Sci Rep. 2021, 11(1): 10109.

[5] Hara H, S Sakaguchi. Virus Infection, Genetic Mutations, and Prion Infection in Prion Protein Conversion. Int J MolSci. 2021, 22(22).

[6] Sakaguchi S, Hara H. The first non-prion pathogen identified: neurotropic influenza virus. Prion. 2022 Dec,16(1):1-6.

[7] Chida J, Hara H, Yano M, et al. Prion protein protects mice from lethal infection with influenza A viruses. PLoSPathog. 2018, 14: e1007049.

[8] Harris DA, True HL. New insights into prion structure and toxicity. Neuron. 2006; 50(3): 353-357.

[9] Aguzzi A, Baumann F, Bremer J. The prion's elusive reason for being. Annual Review of Neuroscience. 2008; 31:439-477.

[10] Venneti S. Prion diseases. Clinics in Laboratory Medicine. 2010; 30(1): 293-309.

[11] Aguzzi A, Montrasio F, Kaeser PS. Prions: health scare and biological challenge. Nature Reviews: Molecular CellBiology. 2001; 2(2): 118-126.

[12] Denkers ND, Seelig DM, Telling GC, Hoover EA. Aerosol and nasal transmission of chronic wasting disease in cervidized mice. The Journal of General Virology. 2010; 91(6): 1651-1658.

[13] Haybaeck J, Heikenwalder M, Klevenz B, Schwarz P, Margalith I, Bridel C, Mertz K, Zirdum E, Petsch B, Fuchs TJ, Stitz L, Aguzzi A. Aerosols transmit Prions to immunocompetent and immunodeficient mice. PLoS Pathog. 2011; 7(1): e1001257. World Journal of Biology Pharmacy and Health Sciences, 2022, 10(03), 031–035 35

[14] Makarava N, Kovacs GG, Bocharova O, Savtchenko R, Alexeeva I, Budka H, Rohwer RG, Baskakov IV. Recombinant prion protein induces a new transmissible prion disease in wild-type animals. Acta Neuropathologica. 2010; 119(2): 177-187.

[15] Gonçalves D, Prado RQ, Xavier EA, de Oliveira NC, Guedes PMDM, da Silva JS, et al. Corrigendum toImmunocompetent Mice Model for Dengue Virus Infection. Scientific World Journal. 2018, 5268929.

[16] Eric A Xavier, Fabricio C Machado, Luiz Rodolpho RG Travassos. Immunoglobulin peptide against melanoma. World Journal of Advanced Pharmaceutical and Life Sciences. 2022, 02(01): 009–013.

[17] Eric Almeida Xavier and Fabrício Castro Machado. L18R a peptide with potential against melanoma. Open Access Research Journal of Biology and Pharmacy, 2022, 04(02), 022–027.

[18] Eric Almeida Xavier. G10S an immunoglobulin peptide against melanoma. World Journal of Advanced Research and Reviews. 2022, 14(01), 385–390.

[19] Eric Almeida Xavier. An in vitro test of new peptide against melanoma. World Journal of Advanced Research and Reviews, 2022, 14(01), 024–028.

[20] Weissmann C. A 'unified theory' of prion propagation. Nature. 1991, 352:679–683.