World Journal of Biology Pharmacy and Health Sciences
eISSN: 2582-5542
Cross Ref DOI: 10.30574/wjbphs
Journal homepage: https://wjbphs.com/

(REVIEW ARTICLE)

# Prion/virus the danger of biological weapons

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World Journal of Biology Pharmacy and Health Sciences, 2022, 10(03), 031–035

Publication history: Received on 08 May 2022; revised on 10 June 2022; accepted on 12 June 2022

Article DOI: https://doi.org/10.30574/wjbphs.2022.10.3.0087

## Abstract

If the attacking force has a vaccine before the attack, will inflict a crippling damage on the enemy. Thus, virus emerges as potential danger since they can be used in the development of such weapons. The reported of a neurotropic strain influenza A virus (IAV) induced the conversion of normal prion protein (PrPC) into infectious prion protein (PrPSc) as well as formation of infectious prions bring out the danger of a type of prion/virus as unprecedented infectious pathogens that cause fatal neurodegenerative diseases. Due to their singular characteristics a virus inducer of prion disease can be a stealth advantage for the attacker if he has an effective vaccine. Therefore, lethal prion/virus can be developed by malicious researchers who could use it to attack political enemies.

**Keywords:** Virus; Prions; Biochemical Weapons; Pandemic

## 1. Introduction

A neurotropic H5N1 avian influenza A virus (IAV) strain named A/WSN/33 (H1N1) induced not only the conversion of $PrP^{C}$ into $PrP^{Sc}$ (Figure-1) but also the formation of infectious prions in cultured mouse neuroblastoma N2a cells, investigated by Hara *et al* [1,

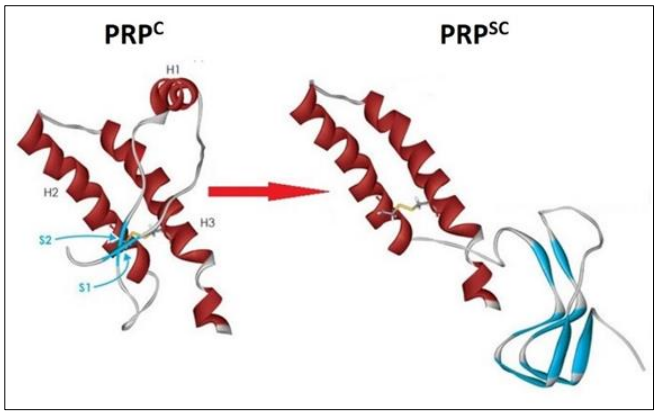


**Figure 1** Normal and infective form

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Normal prion protein ($PrP^{c}$) with 43% of α-helix, sensitive to proteinase K treatment without forming aggregates, that contains the globular domains is well structured the structures contain intramolecular disulfide bridge (S-S yellow trace in Figure), three α-helices, (H1), (H2), and (H3), red color, and a short double-stranded β-sheet (S1) and (S2). (H) and (S) indicate α-helix and β-strand, respectively (indicated by the blue arrows), and a disulfide bridge S-S (trace). ($PrP^{Sc}$) Human Prion protein infectious isoform with 30% of α-helix and 43% of β-sheet, resistant to proteinase K treatment and capable of forming aggregates. The two β-strands (S1) and (S2) are proposed to "seed" β-sheet elongation (gray and blue colors) as the short α-helix (H1) unfolds and is converted into the $PrP^{Sc}$ conformation. (H2) and (H3) remain stabilized via linkage of a disulfide bridge (yellow trace). Courtesy of Cayman Chemical Company. Ann Arbor, Michigan. USA

Fourth and fifth generation warfare involves biological and economic attacks, if the attacking force has the medicine or the population vaccinated before the attack, it will inflict crippling damage on the enemy force. So, the gain-of-function (GOF) experiments result in an increase in the transmission and pathogenicity of potential pandemic pathogens (PPPs) with the risk of using prions as biochemical weapons for mass destruction, described by *Xavie* [3]. Humanity for millennia has been waging wars and using its creativity for the most diverse types of weapons. Various media has been publicizing reports of GOF research laboratories just like the biological dreaded and biochemical weapons. Intelligence agencies of North America and Russian, has been mutually accusing the intended of use weapons, such as, poison, radioactive and GOFs, to use against their political enemies because these attacks are stealthy and frightening. Therefore, in this article we use the term to refer to a hypothetical virus that contains a protein apparatus capable of inducing the formation of prions terminologically termed as "prion/virus". Furthermore, hypothetically, if a prion/virus were used as a biological weapon, they could damage humans, animals and economy of countries; thus, prion/virus can be a very persuasive object for those who have access to it, as described by *Xavie* [3].

## 2. Discussion

Theoretically because $PrP^{Sc}$ uses this via. To propose a mechanism of action of prion/virus, we assume that conformation of prions is pH dependent in endosome-like organelles or lysosomes with acidic environments [4]. So professional antigen presenting cells (APCs) like dendritic cells (DCs) are plausible locations for prion/virus propagation of $PrP^{Sc}$, in lymphoid germinal centers [4,5]. Since prion/virus can be captured by APCs of the immune system, the conformational convertion of $PrP^{c}$ into $PrP^{Sc}$ can be triggered with the drop in pH by endocytosis and the interaction of prion/virus proteins with $PrP^{c}$. So, phagocytic cells may propagate the disease if a particle reaching the central nervous system by sympathetic or parasympathetic nervous from lymphatic tissues (Figure-2).

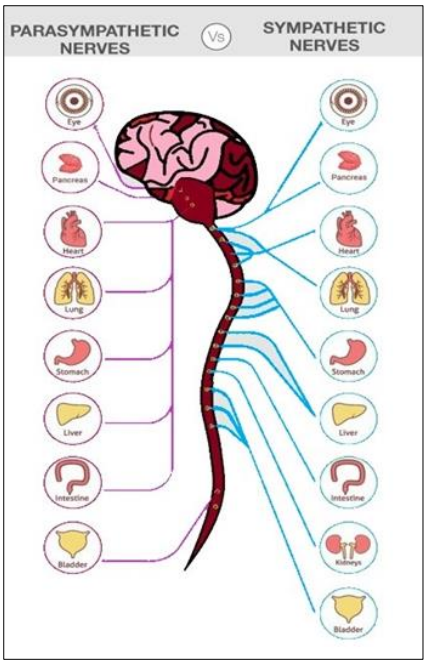


**Figure 2** Illustration mechanism traveled by prion/virus or $PrP^{Sc}$ to reach the brain by transport along the sympathetic or parasympathetic nervous system.

The exact process of entry of ingested $PrP^{Sc}$ from contaminated foods or a prion/virus, $PrP^{Sc}$ into the nervous system is unknown. Didactic entry process can be divided into five steps. (1) Nasal spray or oral intake of prion/virus and $PrP^{Sc}$, (2) $PrP^{Sc}$ survives digestive enzymes of the gastrointestinal tract, (3) prion/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 $PrP^{Sc}$ in gut-associated lymphoid tissues and (4) prion/virus or $PrP^{Sc}$ 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. Prion/virus and $PrP^{Sc}$ may also be transported to draining lymph nodes to more remote regions, such as the tonsils, by lymphatics. (5) $PrP^{Sc}$ is proposed to reach the brain by transport along the sympathetic or parasympathetic nervous system.

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 [6-9].

So, an obvious advantage of using a prion/virus over a pure prion weapon would be the 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. Important experimental trials have shown that infectious recombinant prions can be dispersed by aerosol, see (Figure-3 A-B) [10,11,12].

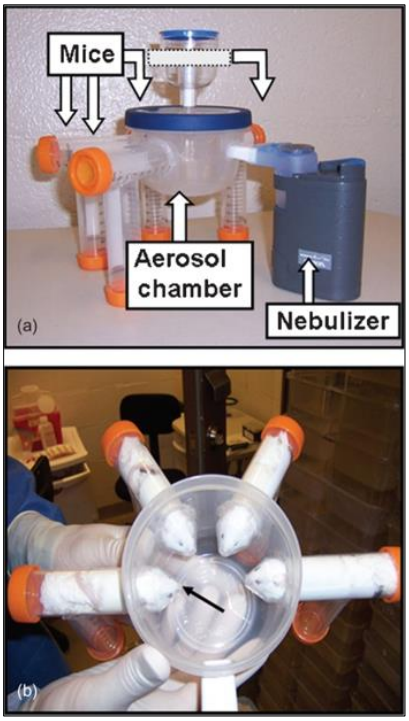


**Figure 3** Prion aerosolizing. (a) Apparatus with aerosolizing chamber with nebulizer of four plastic enclosures to accommodate mice. (b) Top view of Apparatus so, the mice is inserted in place to provide nose-only exposure to the chamber (arrow). Courtesy of Journal of General Virology, Microbiology Society, London. United Kingdom

In addition, the decontamination of the environment can be a huge problem [13]. If prion/virus or $PrP^{Sc}$ is dispersed in the air and made in laboratories with this purpose could kill a large number of people, since the sole as water can be the reservoir of infectious prions [13-17]. Thus, a nation can develop and refine through gain-of-function experiments a virus that causes prion disease in relatively simple laboratories using animals such as rats, mice, and monkeys [18-21].

As a general feature, prion diseases have a sinister characteristic, which is the long incubation time [22-28]; but the quantitative viral load of the primary infection and chronic contact with viral particles or $PrP^{Sc}$ could also be taken into account in development of acute or chronic type of illness. For example as well as ricin has already been used as a weapon, in the case that caught attention of media described by Papaloucas *et al* [29] about a political dissident that was killed by an alleged Russian secret service assassin using an umbrella as a weapon. Consequently, prion/virus can be delivered by simple objects without giving the target any chance to receive a treatment. Some political enemies must be eliminated and prion/virus can be a possible alternative to the use of venoms, precisely because prions do not kill instantly and make the investigation process very difficult to trace the assassin agent. Another class of venom that have

been used before and can be substituted by prions are the radioactive venom [30] because prions can cause the same horror effect with the advantage of no detectable by anti-gama; so, is a stealthier element for the weapon operator agent willing to use it

## 3. Conclusion

We cannot underestimate the immense adaptability of viruses, as well as their ability to adapt and transfect different species. 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. Bioterrorism is a huge problem that emerging with the development of biotechnology. 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.

## Compliance with ethical standards

### *Acknowledgments*

The authors are grateful to Cayman Chemical Company, Ann Arbor, Michigan. USA. And Journal of General Virology, Microbiology Society, London. United Kingdom.

### *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.

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