N-95 Face Mask for Prevention of Bird Flu Virus: An Appraisal of Nanostructure and Implication for Infectious Control

Viroj Wiwanitkit

Accepted: 10 March 2006
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Bird flu or avian flu, caused by the H5N1 virus, is a new emerging infectious disease. There has been a world-wide problem regarding avian influenza infections in poultry since 1997. It is noted that this H5N1 virus jumped the species barrier and caused severe disease with high mortality in humans in Vietnam and Thailand (http://www.thaigcd.ddc.moph.go.th/avianflu_FAQ_en.html).

For prevention of airborne viral infection, N-95 masks are the gold standard that might be applicable to the bird flu infection [1]. Because most viruses are approximately spherical, the virus is modeled as a sphere moving through the mask's pore [2]. Its motion is influenced by convection in the carrier fluid, by diffusion, and by short-range interactions with the pore walls [2]. Interactions that trap the virus against the pore wall are the primary barrier to transmission [2]. This concept can be used for predicting transmission of the avian flu virus via eggshell. In this article the author analyzed the feasibility of avian flu virus passing through the N-95 mask by taking nanostructure level into consideration. The basic concept is that if the size of the virus is larger than the pore size of the N-95 mask, the virus cannot pass through the pores [2].

The author searched for the size of the virus and the pores of the N-95 mask in the literature. According to the search, the size of the pores of the N-95 mask is about 300–500 nm in diameter [5] and the size of the avian flu virus is about 100 nm (<http://www.users>.

rcn.com/jkimball.ma.ultranet/BiologyPages/I/Influenza.html). Based on the particle size as a single factor, the pore size of the N-95 mask is about 3–5 times larger than the size of the virus. The author hereby proposes that the transmission on the avian flu virus through the N-95 mask is feasible. Indeed, the possibility that SARS, a virus of similar size to the avian flu, can pass through the N-95 mask has also been reported [4]. In addition, the N-95 mask also has about a 10% leakage problem around the mask [3]. It should also be noted that N-95 masks, at best, provide a seal with external leakage in the 3%–5% range. This assumes that the wearer of the mask has been properly fitted for the mask and is wearing the mask properly. The amount of inspired air that would bypass the filter and be brought around the filter and into the respiratory tract may be considerably larger. This is most apparent in individuals who are not wearing a mask correctly or who are not adequately trained in the proper fit of an N-95 mask. This is particularly problematic for family members and nonmedical personnel who may wish to use N-95 masks to prevent transmission of respiratory viruses. Therefore, there is no doubt about the possibility of the avian flu virus passing through the N-95 mask.

However, transmission through the N-95 mask does not mean a person will be infected. There are many other factors that contribute to infection. In addition, influenza transmission generally occurs through small aerosol particles in the range of 1–10 μm in diameter. It is possible that individual virions are transmitted person to person, but most transmissions occur in small aggregates of viruses that would be effectively blocked by an N-95 mask. Using a mask does reduce the risk of infection compared with not using a mask. Also, the

V. Wiwanitkit (✉)
Department of Laboratory Medicine, Faculty of Medicine,
Chulalongkorn University, Bangkok, Thailand 10330
E-mail: wwiroj@yahoo.com

general universal precautions, especially washing the hands after contact with a person with respiratory infection, should be followed.

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