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Fatalness of virus depends upon its cell fractal geometry

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A B S T R A C T

Why do more complex viruses (e.g., HIV, AIDS-virus and SARS coronavirus) tend to be more fatal? The paper concludes that the cell fractal geometry of viruses is the key. This paper also suggests two possible new approaches using nanotechnology and temperature to cure or prevent virus infection.

1. Introduction

Just like human brain cells which have higher fractal dimension [1] than that of the general sphere cells, viruses are metabolically active having higher metabolic rate than the infected sphere cells due to their unsmooth surfaces having higher fractal dimension.

For a single sphere cell, its metabolic rate, b, scales as follows [2,3]:

$$b \propto r^2, \tag{1}$$

where r is the radius of the cell. However, for a virus, its metabolic rate, b_{virus}, scales as follows:

$$b_{\text{virus}} \propto r_{\text{virus}}^D, \tag{2}$$

where r_{virus} is character radius of the virus, D is the fractal dimension of its surface, and it follows $2 < D < 3$. Fig. 1 illustrates various viruses' surfaces.

Metabolic rate reflects both the ability of the organism's transport system to deliver metabolites to the tissues and the rate at which the tissues use them [4]. As it is well-known that four metabolically active organs, brain, liver, kidneys and heart together account for ~60% of energy expenditure in humans, even though the four organs represent <6% of body mass [5].

When, e.g., an HIV virus, invades an organ, due to its higher fractal dimension of its surface, it can obtain enough energy for reproduction. The procedure is slow but fatal.

2. Nanotechnology for virus prevention

There are many methods to explain various phenomena in biology, such as allometrical method [6,7], statistical method [8] and E-infinity theory [9,10]. In particular, using a blend of the methodology of allometrical scaling and E-infinity theory it was possible to solve various basic problems in biology [11]. Hereby we suggest a novel approach to prevent virus infection by controlling the fractal dimension of virus' surface using nanotechnology.

Electrospinning is now widely used to produce nanofibers [12–17]. Indigestible nano-scale drugs embedded in the digestible electrospun nanofibers should be used. The drugs cannot be absorbed by human cells, but can be absorbed by the unsmooth surface of viruses, making the virus surface smooth, as a result, the fractional dimension of the virus becomes

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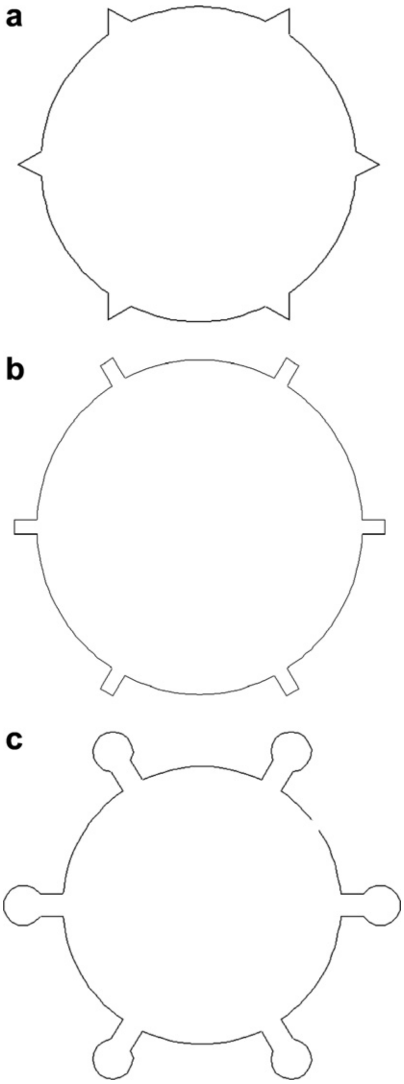

Fig. 1. Various viruses' surfaces: (a) influenza virus; (b) HIV; (c) SARS coronavirus.

smaller up to 2, as illustrated in Fig. 2. The absorbed drugs on the virus' surface also prevent the virus from obtaining enough energy, leading to its final death.

When the metabolic rate of the viruses is not larger than the metabolic rate of its host body, the viruses become harmless [18].

3. Improvement of the host's metabolic rate

Another novel approach is to improve body temperature to improve metabolic rate of the infected man.

The scaling relationship between metabolic rate, B, and body mass, M, can be generally expressed as [19]

$$B \propto M^{\left(\frac{3}{4}+\frac{T-30}{40}\right)}, \tag{3}$$

where T temperature in °C.

We suggests a modification of (3) in the form

$$B \propto M^{\left(\frac{3}{4}+\frac{T-T_0}{4(40-T_0)}\right)}, \tag{4}$$

where T temperature in °C, T_0 is the body temperature.

The prediction (3) is valid within the limited range of "biologically relevant" temperatures between approximately 0 °C and 40 °C. This is the range that organisms commonly operate within under natural conditions. Near 0 °C, metabolic reac-

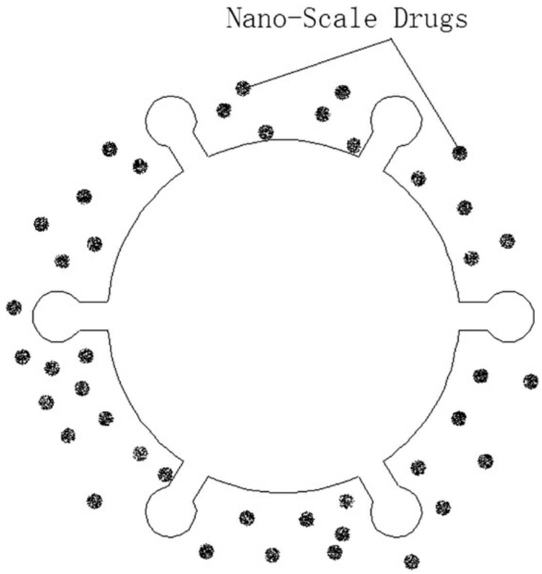

Fig. 2. Nano-scale drugs absorbed on the surface of a virus.

tions cease due to the phase transition associated with freezing water, and above approximately 40 °C, metabolic reaction rates reduced by the increasing influence of catabolism.

The life span L is predicted as

$$L \propto M^{(1-T/40)} \tag{5}$$

or

$$L \propto M^{\left(-\frac{1}{4}-\frac{T-T_0}{4(40-T_0)}\right)}. \tag{6}$$

The increase of temperature leads to the increase of metabolic rate, decrease of life span [20,21], and also stimulates the immune response.

HIV rarely affects monkey, possible explanation is that the body temperature of, e.g., Japanese monkeys (Macaque Fuscata) is 38.6 °C, higher than human.

4. Conclusion

The idea proposed in this paper is simple enough, it provides an alternative way to preventing virus' infection. The successful implementation of the proposed ideas gives a paradigm for preventing from virus infection.

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