Role of Vitamin D in prevention of Corona virus infection (COVID-19)

Surbhi Juneja*, Suwarna Dangore-Khasbage, Rahul R Bhowate
Department Oral Medicine and Radiology, Sharad Pawar Dental College & Hospital, Datta Meghe Institute of Medical Sciences (Deemed to be University), Sawangi (M), Wardha, Maharashtra, India

ABSTRACT

Corona viruses enveloped positive-sense RNA viruses causes various diseases in mammals as well as birds which range from upper respiratory tract infection to potentially lethal human respiratory syndrome. In humans, Severe Acute Respiratory Syndrome corona virus 2 (SARS-CoV-2) causing corona virus disease 2019 (COVID-19) which shows symptoms like fever, sore throat, gasping and ultimately pneumonia, lung injury and leading to death. The virus acts on various systems of our body, and one of them is the Renin-Angiotensin system. It is supposed that the virus causes cell injury by acting on Angiotensin-Converting Enzyme 2 (ACE2) receptors which causes an increase in the level of Angiotensin II, leading to inflammation and lung injury. An essential vitamin can prevent this in our body that is vitamin D. It acts on Renin-Angiotensin system (RAS) by inhibiting the action of renin and also by increasing production of ACE2 and hence Angiotensin II level decreases which prevent inflammation and lung injury. So vitamin D has a remarkable and pivotal role in modulation of the immune system of our body and hence protects human from this fatal disease.

INTRODUCTION

In Wuhan, China a pneumonia epidemic was reported in December 2019 which was detected due to a specific strain of corona virus was named 2019-nCoV by the WHO and later relabeled as SARS-CoV-2 by the International Committee on Taxonomy of Viruses.

"Corona" is a Latin word meaning "crown" or "halo" which allude to the shape of the virus particle when it is viewed under a microscope. Characteristic club-shaped spikes are projecting out from the surface of the virus particle. (Sturman and Holmes, 1983)

Coronaviruses (CoVs) are enveloped, single positive-strand RNA viruses belonging to the sizeable Coronavirinae subfamily which infect birds and mammals. The viral RNA is the largest genome known, and it is between 26 to 32-kilo bases in length. Till now, seven CoVs are identified that causes human disease, which is divided as low and high pathogenic CoVs. (To et al., 2013, Xu et al., 2020)

In the 1930s, coronaviruses were first found, and in the 1960s, human coronaviruses were discovered. (Kahn and McIntosh, 2005). Since then they have been recognised that includes SARS-CoV in 2003, HCoV NL63 in 2004, HKU1 in 2005, MERS-CoV in 2012, and SARS-CoV-2 in 2019.

Coronaviruses cause common symptoms like fever, sore throat due to swollen adenoids, shortness of breath, GIT issues, body aches and severe symptoms such as pneumonia, kidney failure and death. It occurs primarily in the winter and early spring seasons. (Liu et al., 2017)
In humans, coronavirus causes pneumonia, bronchitis and respiratory tract infections ranging from mild to lethal variety. (Forgie and Marrie, 2009). It should be differentiated from other common respiratory diseases such as tuberculosis which contributes to over one-quarter (27.3%) of the global TB burden in India alone. (Sharma et al., 2017). It shows symptoms like cough with expectoration, weight loss, fatigue, night sweats and evening rise in temperature. (Claudius et al., 2017), (Gupta and Bhake, 2017). In about 20–40% cases, tubercular lymphadenopathy may be present that is characterised by caseation necrosis (tubercular abscess) on FNAC examination. (?)

According to WHO, Coronaviruses transmits between animals, and people so are known as zoonotic. They can spread directly through cough or sneeze of an infected person or indirectly by touching contaminated objects.

Pathogenesis
Studies have shown that the human cells are infected by SARS coronavirus due to attachment with the ACE2 receptor leading to inflammation and cell injury. (Li et al., 2005) This damage can be prevented by one of the essential vitamins in our body that is vitamin D which acts on RAS by inhibiting the formation of renin and hence prevents further the formation of angiotensin II which causes inflammation. (Mcmullan et al., 2017)

In pneumonia, sepsis or any other acute lung injury, there is an enhancement in the generation of Angiotensin II (ANG II), mostly due to the downregulation of ACE2 expression.

There is protection against acute lung failure due to the negative regulation of this pathway by ACE2, and Angiotensin II type 2 receptor (AT2R). While SARS-CoV infections depend on the binding of the SARS-Spike protein to ACE2 (and L-SIGN) and downregulate the expression of the protective molecule ACE2, hence promotes severe lung injury and acute lung failure.15

RAS pathway
The renin secreted from kidney converts plasma angiotensinogen to Angiotensin I(ANG I), which is then converted to ANG II by the action of angiotensin-converting enzyme (ACE). (Mcmullan et al., 2017). This angiotensin II is pro-inflammatory, pro-fibrotic, pro-proliferative and causes vasoconstriction and inflammation as shown in following Figure 1.

Later, this angiotensin II is converted into Angiotensin 1-7 which is anti-inflammatory, with the help of ACE 2. So, ACE 2 prevents inflammation and protects against ARDS (Acute Respiratory Distress Syndrome). (Imai et al., 2007)

Role of vitamin D
Vitamin D is an essential vitamin in our body which acts on RAS by inhibiting the formation of renin and hence prevents further the formation of ANG II. And if anyhow this angiotensin II is formed, vitamin D converts it into angiotensin 1-7(Mas receptor) by increasing production of ACE 2. These Mas receptors are the factors which prevent inflammation. (Mcmullan et al., 2017). So, Vitamin D plays a vital role in our body in preventing inflammation and hence, lung injury.

Vitamin D also helps in releasing defence cells
from our body, acting against the virus such as defensins and cathelicidins so protects against the infection. (Gombart, 2009)

But it is a matter of concern that vitamin D deficiency is affecting almost 50% of the worldwide population. (Holick, 2007). Hypovitaminosis D can mainly be attributed to lifestyle and various environmental factors which reduces the sunlight exposure. (Nair and Maseeh, 2012)

In blood, the normal range of vitamin D should be between 30ng/ml-100ng/ml. 20 ng/ml blood levels are sub-optimal for overall health, and 40ng/ml is the minimum desired level. 9122 IU/day intake of vitamin D is needed to reach 40ng/ml. (Papadimitriou, 2017), (Bergman et al., 2013). Thus, the maintenance of vitamin D serum concentration reduces acute viral respiratory tract infections. (Papadimitriou, 2017)

To increase the level of vitamin D in the blood, natural sources are sunlight, milk, mushrooms, cod liver oil, egg yolk. At the same time, supplements and intramuscular injections can also be taken after consulting the physician.

CONCLUSIONS

Vitamin D is not just a nutrient but also a hormone that can be synthesised in our body with the help of sunlight and has an essential function in maintaining the integrity of the bone. Also, it acts as a powerful immune-modulator which provokes numerous cell maturation along with immune cells in our body.

Until now, there is no specific treatment or vaccine for this deadly viral disease, but one should take preventive measures to boost immunity. Therefore, vitamin D may be used as a prophylactic option for this novel virus infection, COVID-19.

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Conflict of Interest
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