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**Matric no: 16/MHS06/066**

**Course: Virology**

TEST

Discuss the etiology, origin, structure and pathophysiology of COVID-19

Answer:

The coronavirus disease also known as COVID-19 is an infectious disease caused a newly discovered coronavirus. Most people infected with the COVID-19 virus will experience mild to moderate respiratory illness and recover without requiring special treatment.

Etiology:

COVID-19 can be gotten by two means, they are:

1. Faecal oral route
2. Respiratory droplet

Faecal oral route: this is when faecal material of an infected person is ingested by another person. It occurs as a result of improper hygiene

Respiratory droplet: this is as a result of inhaling the virus from an infected person through sneezing, coughing. Respiratory droplet can be spread to someone as far as three to six feet. Respiratory droplet can stay on surfaces and survive for approximately 24hours and a person can pick it up and infect him or herself by touching any mucous membrane which include the eyes, mouth and nose. It can also be air borne for 3hours and can be inhaled by another. It can also be spread by asymptomatic carriers by respiratory droplet.

When the virus gets into the respiratory system, it attacks the alveoli. It attaches itself to the type 2 pneumocyte cell in the alveoli. The virus which has different proteins on the spikes. Coronavirus attaches to specific cellular receptors via the spikes protein. The first identify coronavirus receptor was CEACAM 1, utilized by MHV(141). Viral attachment triggers a conformational change in the spike protein that promotes the fusion of viral and cellular membrane. While there are no crystal structures available for any coronavirus spikes, it is believed that it may undergo changes similar to those of other type I fusion proteins, such as influenza virus hemagglutinin and human immunodeficiency virus gp120, in order to mediate fusion of viral and cellular membranes. The coronavirus spike protein plays vital roles in viral entry, cell-to-cell spread, and determining tissue tropism. Coronavirus entry is, in general, not pH dependent, and thus it has been believed to occur directly at the plasma membrane and not via an endosomal route.

 The S spike on the virus binds to the receptors on the type 2 pneumocyte which is called the ACE-2. The binding allows the virus to be engulfed into the cell (penetration). After penetration, the virus then releases the single strand RNA into the cytoplasm and use the host cell ribosomes and translation occurs i.e taking mRNA and converting it into protein and the translator is converted to specific protein molecules. The positive single stranded RNA (SSRNA) can also make use of and enzyme known as RNA-dependent-RNA-polymerase which synthesizes RNA. It takes the ssRNA and makes more copies of ssRNA.

The proteinase enzyme helps to reassemble the virus by combining the RNA and different structures and fixing the specific protein molecules into the different spikes and the virus leaves the cell and goes into another cell and the process continues.

This process leads to the attraction of macrophages which secretes specific cytokines such as interleukin 1 and 6. This secretions goes into the blood stream and cause vasodilation, endothelial cell contraction thereby increasing the capillary permeability. This causes the leakage of blood into the interstitial spaces and into the alveoli and accumulation of blood will them compress the alveoli and part of the blood may enter the alveoli causing alveoli edema. This edema causes the surfactant to drown out and increases the surface tension which leads to increase in collapsing pressure making the alveoli to collapse which reduces the work of breathing.

Interleukin 1 and 6 if released in large amount can travel to the central nervous system. Which sends signal to the hypothalamus to secrete specific prostate glandin by PG2 which helps to reset the thermostat and increase the body temperature which leads to fever.

Inflammation of the lungs leads to increased systemic inflammatory response syndrome (SIRS) which spread around the systemic circulation and leads to leaking out of blood and it’s accumulation in the tissues and vasodilation of the arteriole vessels. This reduces the blood volume leading to hypotension which decreases perfusion to multiple organs thereby causing multiple organ failure.

Origin:

In December 2019, a cluster of pneumonia cases, caused by a newly identified beta-coronavirus, occurred in Wuhan, China. This coronavirus, was initially named as the 2019-novel coronavirus (2019-nCoV) on 12 January 2020 by World Health Organisation (MHO). WHO officially named the disease as coronavirus disease 2019(COVID-19) and Coronavirus Study Group (CSG) of the International Committee proposed to name the new coronavirus as SARS-CoV-2, both issued on 11 February 2020. The Chinese scientists rapidly isolated a SARS-CoV-2 from a patient within a short time on 7th January 2020 and came out to genome sequencing of the SARS-CoV-2.

The SARS-CoV-2 is a beta-coronavirus, which is enveloped non-segmented positive-sense RNA virus (subgenus *sarbecovirus, Orthocoronavirinae* subfamily). Coronaviruses(CoV) are divided into four genera, including α−/β−/γ−/δ-CoV. α- and β-CoV. are able to infect mammals, while γ- and δ-CoV tend to infect birds. Previously, six CoVs have been identified as human- susceptible virus, among which α-CoVs HCoV-229E and HCoV-NL63, and β-CoVs HCoV-HKU1 and HCoV-OC43 with low pathogenicity, cause mild respiratory symptoms similar to a common cold, respectively. The other two known β-CoVs, SARS-CoV and MERS-CoV lead to severe and potentially fatal respiratory tract infections. It was found that genome sequence of SARS- CoV-2 is 96.2% identical to a bat CoV RaTG13, whereas it shares 79.5% identity to SARS-CoV. Based on virus genome sequencing results and evolutionary analysis, bat has been suspected as natural host of virus origin, SARS-Cov-2 might be transmitted from bats via unknown intermediate hosts to infect humans. It is clear now that SARS-CoV-2 could use angiotensin-converting enzyme 2 (ACE2), the same receptor as SARS-CoV, to infect humans.

Structure:

Spherical or pleomorphic enveloped particles containing single-stranded (positive-sense) RNA associated with a nucleoprotein within a capsule comprised of matrix protein. The envelope bears club-shaped glycoprotein. The envelope bears club-shaped glycoprotein projection.

Pathophysiology:

The viral replication process leads to the attraction of macrophages which secretes specific cytokines such as interleukin 1 and 6. This secretions goes into the blood stream and cause vasodilation, endothelial cell contraction thereby increasing the capillary permeability. This causes the leakage of blood into the interstitial spaces and into the alveoli and accumulation of blood will them compress the alveoli and part of the blood may enter the alveoli causing alveoli edema. This edema causes the surfactant to drown out and increases the surface tension which leads to increase in collapsing pressure making the alveoli to collapse which reduces the work of breathing.

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