Review Article

Coronavirus and Disease such as Cancer

Abstract

A recently published article confirmed that more than 50.0% of infected patients with cancer are susceptible to develop severe form of coronavirus disease 2019 (COVID-19). Currently, acute and chronic diseases caused by COVID-19 in humans are spreading quickly worldwide. Therefore, this study aimed to provide a better understanding of the COVID-19 and disease such as cancer. Based on our previous studies and experiences in the field of cancers' prevalence and incidence, we searched, selected, and studied articles in PubMed (National Library of Medicine), Scopus, and Web of Science with the keywords relevant to "Coronavirus," "Disease," and "Cancer." In the initiation of cancer, viral infection plays a key role in signaling factor activation. Due to immunocompromised state, there is a higher risk of severe illness such as severe acute respiratory symptoms from COVID-19 in those with cancer. Patients with lymphoblastic leukemia or those who need to undergo chemotherapy are at higher risk for COVID-19 infection. Mild flu-like symptoms, fever, cough, fatigue, sputum production and shortness of breath, respiratory failure, arrhythmias, brain stroke, acute cardiac injury, shock, multiple organ failure, and death are some of the reported signs of infection to COVID-19 in patients with cancer. Published articles, emphasis for more attention during COVID-19 pandemic situation in patients with different types of cancers such as; Skin, stomach, colon, bladder, and lung cancer. Forecasts a time of change for a new type of coronavirus that might be associated with a silent period of at least 3–7 years in the near future. Finally, as patients with cancer are more susceptible to develop severe clinical consequences, therefore, health authorities should have advanced pharmacotherapy plans to alleviate the adverse effects of the COVID-19 on cancer patients.

Keywords: *Cancer, coronavirus, disease, immunocompromised*

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Introduction

The novel severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is the strain of coronavirus that caused coronavirus disease 2019 (COVID-19) and the first event appeared in Wuhan, China. The COVID-19 was characterized by the World Health Organization (WHO) in March 2020 as an epidemic situation that needs international concern associated with public restrictions.

Figure 1 shows the history of different types of coronavirus discoveries. In fact, birds and human coronaviruses (HCoVs) were first discovered in the 1930s and 1960s, respectively. In 1968, a group of virologists designates this new family of RNA viruses with subtype of Coronaviridae, Nidovirales, and Riboviria. It causes mild-to-severe respiratory tract infections. Related to its structure, the large marginal round external layer creates duplicate indicative of the solar crown. On the viral capsid or envelope, there is a glycoprotein that binds to certain receptors on the host cell. In 1965, Tyrrell and Byone successfully cultivated the novel virus by serially passing it through the organ culture of human embryonic trachea. HCoV-229E and HCoV-OC43 (OC for organ culture) that were morphologically related to infectious bronchitis virus were introduced in 1967. Later on, in 2003 SARS-CoV, in 2004 HCoV-NL63, in 2005 HCoV-HKU1, in 2012 Middle East respiratory syndrome-related coronavirus (MERS-COV), and in 2019 SARS-CoV-19 were introduced. The most important part associated with virus infectivity and host specificity is the peplomer or glycoprotein spike or viral capsid or envelope.

Spike glycoprotein, M-protein, hemagglutinin-esterase dimer (into a member of betacoronavirus subgroups), and E-protein are the main components in the

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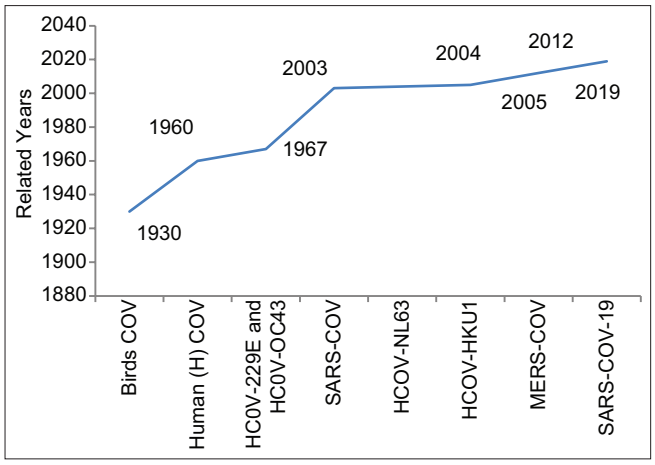

Figure 1: History of different types of coronavirus discovery reports

envelope and inside there is RNA and N protein. The viral envelope consists of a lipid bilayer with envelope: spike and membrane ratio of 1:20:300. A particle of coronavirus has approximately 74 surface spikes.

There is not enough information regarding risk, presentation, and outcomes of SARS-CoV-2 (COVID-19) infection in cancer patients, transplant recipients, or diabetic patients. It can cause kidney and multiorgan failure. A study of 7 kidney transplant recipients suggested that COVID-19 infection in kidney transplant recipients could be severe, requiring intensive care admission with the symptoms predominately respiratory and associated with fever.[1-7] In individuals on chemotherapy or radical radiotherapy for lung cancer or in those with leukemia, lymphoma, or myeloma it is reported that they are at higher risks for increasing severe clinical form of COVID-19. The aim of this study was to provide review associated with coronavirus and disease such as cancer.

Methods

Data of this review were collected from our previous studies and experiences in the field of cancers' prevalence and incidence from the Directory of Open Access Journals, PubMed, Scopus, and Web of Science with keywords relevant to "Coronavirus," "Disease," and "Cancer."[4-7, 25-34]

Results

Between December 31, 2019, and July 6, 2021, published reports indicated 184,925,412 cases and 4,000,525 deaths worldwide being caused by COVID-19.

Because of the malignancy and anticancer treatment, patients with cancer are more subject to COVID-19 infection than those without cancer as they are in an immunocompromised state. A study of patients with cancer and COVID-19 showed that the most common cancers were lung, gastrointestinal, and genitourinary cancers. In those receiving anticancer treatment, the rate of development to severe form of COVID-19 was higher than others.[8-12]

In host cells, coronavirus binds to a surface receptor through its S1 subunit and then fuses viral and host membranes through its S2 subunit. Viral attachment could be recognized by a variety of host receptor associated with two domains of S1 subunit from different coronaviruses.[12,13] The spike protein exists in two structurally distinct conformations, prefusion and postfusion.

Replicase polyproteins could occur by genome translation due to receptor-mediated endocytosis and the release of the genome into the cytosol. After polyprotein cleavage caused by multiple internal proteases, the coronavirus causes those structural proteins into a reverse transcription complex. The four common structural proteins of COVID-19 are the genes (S, E, M, and N) and a sequence that has a dividable length that bounded by stop or termination codons. The resulting ten cleavages (nonstructural proteins) are indicated as the conserved replicase domains.[13]

From exposure to symptom onset, the incubation period is 11.5–14 days (median time of 4–5 days) days. Fever, cough, fatigue, anorexia, shortness of breath, sputum production, and myalgias are the most signs of COVID-19.[14-20]

Regarding other diseases, there are complex interactions with COVID-19. In population of patients with diabetes cytokine induced insulin resistance, straight β-cell impairment, use of renin–angiotensin–aldosterone system antagonists, could contribute to poor prognosis in clinical condition. In fact, infection of COVID-19 could place such patients at a high risk of severe disease, acute respiratory syndrome, and eventual mortality [Figure 2].[20] In distinct central nervous system cell type, infection to COVID-19 could control the replication of the virus by both innate immune response and specific host effector mechanisms. During acute infection, nonlytic humoral immunity prevails in suppressing infectious virus through persistence.[19,20]

During the pandemic COVID-19, there are significant urologic challenges in the field of urology because a large number of patients are men over 50 years old. A screen for neutralizing antibody revealed that 87.2% of patients on dialysis were positive.[21-23]

Discussion

Increasing attention to the SARS-COVID pandemic has been specified since December 2019. Subtypes of 229E, OC43, and NL63 tend to be transmitted mainly through the winter season in temperature climate countries. NL63 is primarily associated with young children, the elderly, and immunocompromised patients with respiratory illnesses. There is a 96.2% genomic similarity of human SARS-COVID-2 to bats' coronavirus.[24] Therefore, more care should be assumed to the patients with special disease such as cancer.

A study of outcomes regarding COVID-19 in a large cohort of patients with different cancer types suggested a high

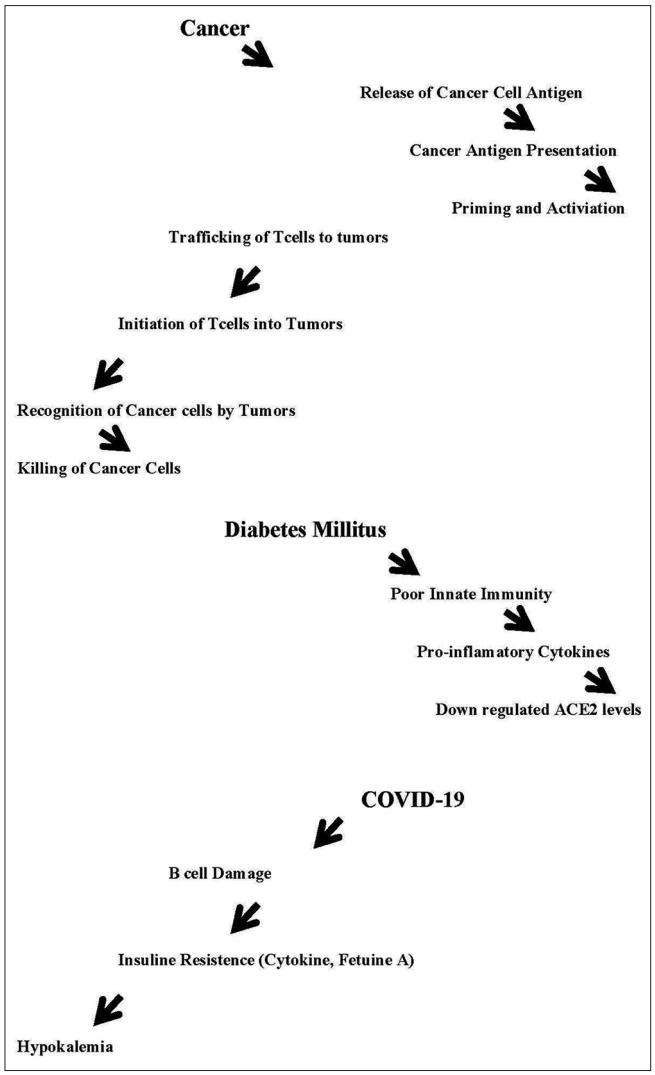

Figure 2: COVID-19 and disease such as cancer and others

incidence of severe illness and case fatality rates compared with the community population. In addition, another study showed that interleukin-6 peak levels are associated with the severity of pulmonary complications.[8-11] A recent study in Isfahan/Iran, showed that the prevalence for different types of cancer were ranked as; breast, digestive system, genital system, skin, urinary system, respiratory system, endocrine system, and so on. As a result the effect of COVID-19 in such patients need special attention in Iran and worldwide.[25-34] Palpitation, chest tightness, mild nasal congestion to severe tracheobronchitis, pneumonia, and respiratory failure might be observed in those with cancer or any other disease. The rate of progression to lower tract disease is greater with certain viruses, pediatric age group, and greater state of immune suppression. A study based on evaluation of patients for symptoms, laboratory data, imaging findings, and outcomes showed that fever, cough, and dyspnea were the most common clinical symptoms, noted in patients with cancer. Most of the patients had a normal white blood cell count, while leukopenia and leukocytosis were reported in some others.[4-34] Animal-to-human and inter-human transmissions of this viral infection through respiratory route were established by a certain group of scientists.[4,35-37] Human-to-human transmission of SARS-COVID-19 and MERS-COVID-19 occurs mainly through nosocomial transmission; 43.5%–100% of MERS cases in individual outbreaks were linked to hospitals, and very similar observations were made for some of the SARS clusters.[38]

Regarding pharmacotherapy of COVID-19 in general and patients with cancer in particular, drugs should target coronavirus or host factors that are highly conserved among C0VID-19 or are essential for C0VID-19 replication. A small analog nucleoside (GS-5734) such as Filoviridae, Pneumoviridae, Paramyxoviridae, and Coronaviridae has shown antiviral activity. In addition, lopinavir–ritonavir that was initially developed as an HIV-1 protease inhibitor could also affect SARS-CoV nonstructural protein 3. Ribavirin a guanosine analog with *in vitro* activity against a large number of highly lethal emerging viruses inhibits RNA synthesis and increases the rate of viral mutations leading to accumulation of defective virions.[35-42] These drugs need more attention regarding as polypharmacy in patients with cancer as could bury pharmacokinetic interaction due to cytochrome P450.

Evidence-based pharmacotherapy used ribavirin, lopinavir–ritonavir in addition to corticosteroids showed a lower 21-day acute respiratory disease syndrome and death rates than those who received ribavirin and a corticosteroid.[38,40-42] Pharmacotherapy used interferon alpha-1 in addition to corticosteroid was associated with improved oxygen saturation and more rapid resolution of radiographic lung opacities than systemic corticosteroid alone.[41] Disseminated fungal infection and avascular osteonecrosis occurred following prolonged systemic corticosteroid therapy. Plasma COVID-19 levels in weeks 2–3 of the illness were higher in patients given hydrocortisone (n = 10) than those given normal saline (n = 7) in the early phase of the illness, suggesting that early use of pulsed corticosteroid might prolong viremia. Plasma therapy in convalescent phase has been used for a reduction in mortality, but the treatment success was determined by its availability and timely administration.[42-45]

Conclusion

At this point in time, data pertaining to the effect of COVID-19, cancer, and immunocompromised state seem more hypothetical. Further evidence-based data are needed to confirm different clinical presentations of COVID-19 and its management in those with cancer. The access for health-care and pharmacotherapy facilities in patients with cancer should be based on adjusted program.

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Conflicts of interest

There are no conflicts of interest.

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