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Adverse Effects of COVID-19 in Patients with Age Associated Diseases: A Mini Review

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ABSTRACT: *The world is currently suffering from a pandemic called COVID-19 caused by the SARS-CoV-2 extreme acute respiratory syndrome coronavirus, first identified on December 31, 2019 in Wuhan, Hubei Province, China. In this review, the main focus is on the individuals infected with coronavirus while suffering from various age associated diseases such as hypertension, diabetes, obesity, and coronary heart diseases. The risk of complications such as Adult Respiratory Distress Syndrome and multi-organ failure is higher for coronavirus patients with diabetes. Depending on the global region, 20–50% of patients who were COVID positive had diabetes. Moreover, 30% of the COVID-19 patients were found with hypertension. Among COVID patients of age 50 and above, hypertension was observed as one of the most common comorbidities with increased rate of hospitalization and death. This short review highlights the basics of corona viruses, focusing on COVID-19 as well as their effects on people with age associated diseases.*

Keywords: *COVID-19, Diabetes, Hypertension, Coronary heart disease, Obesity*

INTRODUCTION

Corona viruses (CoV) are the enveloped viruses and these viruses are single-stranded RNA viruses with a positive-sense genome which are well-known for causing respiratory diseases in humans (Su et al., 2016; Cui et al., 2019). Mostly, COVID-19 infection leads to minor upper respiratory infection in most of the immune competent individuals (Zaki et al., 2012). Conversely, in 2003 in Guangdong, China one of the two extremely pathogenic CoV have become a cause of epidemics of Severe Acute Respiratory Syndrome (SARS), while a

decade later another CoV Middle East Respiratory Syndrome (MERS) resulted in outbreak in Middle Eastern countries. Both of the SARS-CoV and MERS-CoV were known for causing SARS and MERS correspondingly. In December 2019, SARS-CoV-2; a unique type of Coronavirus (COVID-19), was recognized as coronavirus causing pathogen (Zhong et al., 2003). It was first identified in Wuhan, China. Later, after 2 months WHO declared COVID-19 as pandemic by the mid of March 2020. By the end of the month of March, in the United States, there have been reported a total of 103,942 confirmed COVID-19 cases and 1689 deaths. Worldwide, the number of confirmed cases was 595,800 and total of 27,324 deaths were stated (Muniyappa and Gubb, 2020).

However, the most likely group of the people infected with COVID-19 are the individuals having previous history of diseases i.e. hypertension, and severe obesity (BMI> 40 kg/m^2) and Diabetes Mellitus (DM) etc. and also the higher death rate is observed in these individuals (Zhang et al., 2020).

Patients with Diabetes Mellitus were also more likely to contract SARS and MERS. However, Diabetes Mellitus have affected 10.5% of the overall population of the United States. People aged 65 and over are at a higher risk of dying from COVID-19, with 26.8% already having Diabetes Milletus (Muniyappa and Gubbi, 2020).

And of individuals diagnosed with Diabetes Mellitus, severe obesity and Hypertension are present in 15.5% and 68.4% respectively. A large portion of the US population would become infected with SARS-CoV-2 over a period of months. While a large number will remain asymptomatic and allow the virus to spread, the estimated proportion of people who need hospitalization will rise with age. Additionally, in the older group of hospitalized patients, those who require ICU care are 71% (Ferguson et al., 2020). Since the Diabetes Mellitus, excessive obesity, and hypertension are prevalent in the United States, as well as the much increased risk of COVID-19 and associated complications in patients with these diseases, the pandemic could result in significant mortality and morbidity (Muniyappa and Gubbi, 2020).

COVID-19 AND AGE ASSOCIATED DISEASES

It is now well understandable that the aged or older people with the history of already existed diseases i.e. Diabetes Mellitus, severe obesity and hypertension increases the mortality and

morbidity rates, in patients with COVID-19 (Zhang et al., 2020). It is unidentified whether only the diabetes mellitus is contributing to the increased risk of the patients, when we think through the high prevalence of cardiovascular disease, hypertension and obesity, in patients with diabetes mellitus. Though, plasma glucose levels and diabetes mellitus are independent analysts for morbidity and mortality in patients with SARS (Yang et al., 2006). Possible mechanisms that increased the vulnerability for COVID-19 in patients with diabetes mellitus include multiple parameters such as the greater affinity cellular binding or efficient viral entry within the cell, decreased rate of viral clearance, function of T cell diminished, more susceptibility to cytokine storm syndrome and hyper inflammation and the presence of cardiovascular disease (Muniyappa and Gubbi, 2020). Some of the studies have also reported that COVID-19 is related with hyperglycemia mostly in the aged people with type 2 diabetes (Xu et al., 2020).

COVID-19 AND HYPERTENSION

Importantly, it has been reported that particular comorbidities linked with higher risk of infection and adverse outcomes associated with the development of severe lung injury and mortality. The one of the most common reported comorbidity is hypertension that was reported as 30%, diabetes and coronary heart diseases was reported as 19% and 8% respectively (Zhu et al., 2020). One study showed that hypertension was 27 percent of the most common comorbidities in patients with COVID-19 who experienced Acute Respiratory Distress Syndrome (ARDS), while diabetes and cardiovascular diseases were 19 percent and 6 percent, respectively (Wu et al., 2020).

The rate of recurrence with which COVID-19 patients are hypertensive is not fully unexpected, nor does it generally suggest a causal association between hypertension and COVID-19 or its severity, as hypertension is extremely common in the elderly, and it appears that older people are at greater risk of SARS-CoV-2 virus infection and suffering from more extreme forms and difficulties (Schifrin et al., 2020).

Recent studies showed that proportion of hypertension among COVID- 19 patients, ranged from 15%-20% (Guan et al., 2020; Lianet al., 2020; Huang et al., 2020) to 30%-35% (Shi et al., 2020; Guo et al., 2020; Chen et al., 2020). These variations might have aroused due to the various reasons. Patients with elevated proportion of hypertension relatively belonged to the

higher age group (Guan et al., 2020;Lian et al., 2020) which could be a reason for these variations in proportions of hypertension. Aging is also associated with different comorbidities such as arterial hypertension, renal impairment, obesity and diabetes. These comorbidities altogether increased proportion of hypertensive patients (Liu et al., 2020).

In recent study, out of 788 COVID patients aged 46 years on average only 16% were hypertensive (Lian et al., 2020). In another study, the positive cases were 274 aged 64 years out of which 34% were hypertensive. This showed a strong association between age and hypertension among COVID patients. Moreover 48% of the hypertensive COVID positive patients aged between 62-77 years could not survive the COVID-19 infection (Chen et al., 2020).

COVID-19 AND DIABETES

Diabetes is a most important risk factor for the development of severe pneumonia due to infection of virus and it occurs in about approximately 20% of patients (Hespanhol et al., 2019; Zou et al., 2020). Diabetes was recognized as a most important contributor to the infection. Data from epidemiological studies in areas where the population has been seriously affected by SARS-CoV-2 and numerous other findings from national health centers and hospitals and the Centers for Disease Control and Prevention (CDC) suggested that the risk of death from COVID-19 in patients with diabetes is up to 50 percent higher than in patients without diabetes (Perico et al., 2020). Many hypotheses have been explained regarding the severity and higher incidence rate of COVID-19 infection in the diabetic people. Over-all, people with all forms of diabetes are at higher risk of COVID-19 infection owing to weaknesses of innate immunity which is affecting neutrophil chemotaxis, phagocytosis, and cell-mediated immunity; however, the high rate of diabetes in serious cases of COVID-19 might strongly reflect the greater spread of type 2 diabetes in older people. Moreover, diabetes in people with older ages is also linked with cardiovascular diseases, which itself another factor, to describe the association of COVID-19 with more fatal outcomes (Bornstein et al., 2020).

Since inflammatory responses such as cytokines storms is relatively higher in patients with diabetes and associated liver diseases, so these patients are at more risk of contracting severe COVID-19 infection. Consequently, these inflammatory responses should be

screened frequently using various laboratory methods such as high-sensitivity C-reactive protein, erythrocyte sedimentation rate increasing ferritin or decreasing platelet counts. These methods can also be helpful in determining the type of immuno-suppressors that can be administered to such patients who have elevated inflammatory response. Selective cytokine blockade, immunoglobulins or steroids can be used as immuno-suppressors in such cases (Bornstein et al., 2020).

The diabetic patients often develop comorbidities such as obesity and overweight which disrupts the body mass index that may lead to altered respiratory mechanics, oxygenation during mechanical ventilation or lung volume. Hence, the diabetic and obese patients may experience more complications in case of acquiring ventilator support. As discussed earlier the immune response, both innate and adaptive is altered in such patients so they may develop chronic inflammation with high concentrations of lower anti-inflammatory adiponectin and pro-inflammatory leptin (Andersen et al., 2016).

COVID-19 AND CARDIO-VASCULAR DISEASE

Appearing to affect the myocardium, SARS-CoV-2 has become a source of myocarditis. Sporadic autopsy cases indicate myocardial invasion by interstitial inflammatory mononuclear cells (Xu et al., 2020). Parallel to this, after COVID-19, cases of extreme myocarditis with decreased systolic function were identified. As indicated by cardiac biomarker research, a high prevalence of heart injury has been identified in hospitalized patients (Xu et al., 2020; Shi et al., 2020; Guo et al., 2020). Myocardial injury is likely to be linked to myocarditis associated with infection and remains an important prognostic dynamic in COVID-19 (Madjid et al., 2020).

It has been observed during the influenza epidemics that majority of the people died because of the cardiovascular diseases instead the cause of their death was pneumonia-influenza (Madjid et al., 2004).

Recent studies showed an association amongst cardiovascular metabolic diseases and MERS and SARS (Yang et al., 2006; Badawi and Ryoo, 2016). A total of 637 MERS-CoV cases were analyzed which showed that hypertension and diabetes are present in 50% of the cases while cardiac diseases are prevalent in 30% of the patients (Badawi and Ryoo, 2016). As the

COVID-19 spreads and the number of cases increases, it has been observed that large number of COVID-19 infected individuals show comorbidities i.e. diabetes, cardiovascular diseases and hypertension. In another study 99 cases was analyzed, out of which 40% patients had cardiovascular disease (Chen et al., 2020), further in 41 cases of Huang's study, 20% patients were diabetic (Huang et al., 2020).

Moreover, it has been reported that patients infected with corona virus can develop long-term metabolic alterations, as has been reported previously with the SARS virus. Hence, a special care is needed for the cardio-metabolic nursing of patients who have survived severe COVID-19 disease (Li et al., 2020).

SARS-CoV-2 patients develop more severity when the virus's S-protein binds to the angiotensin- converting enzyme 2 (ACE2), which is extensively expressed in the kidneys, gastrointestinal system, lungs and heart and it plays a key role in multiple cardiovascular and immunological pathways (Walls et al., 2020).

According to the studies conducted on January 2020 in the different hospitals of china, the viral infection was observed in the people with cardiovascular diseases described in the table 1.

Table 1: Number, age, sex and cardiovascular metabolic diseases of patients (Li et al., 2020)

Hospital	Number of patients	Ages	Sex (male %)	Cardiovascular metabolic diseases		
				Hypertension %	Diabetes %	Cardiovascular diseases %
Zhongnan Hospital	138	56 (42–68)	54.3	31.2	10.1	9.6
Jinyintan Hospital	41	49 (41–58)	73	15	20	15
552 hospitals in China	1099	47 (35–58)	59.2	14.9	7.4	3.9
9 tertiary hospitals in Hubei	137	57 (20–83)	44.5	9.5	10.2	7.3

COVID-19 AND OBESITY

Intestinal obesity is linked with diminished ventilation of the base of the lungs which in return resulting in low oxygen saturation of blood (Peters and Dixon, 2018). Moreover, the irregular exudation of cytokines and adipokines such as interferon and tumor necrosis factor-alpha describe a chronic low-grade inflammation characteristic of intestinal obesity, which may harm the immune responses (Huttunen and Syrjanen, 2013) and have the adverse effects on the bronchi and lung parenchyma (Zhang et al., 2018). Overall, it seems probable that obesity possibly will be an independent risk factor for SARS-CoV-2 (Ryan et al., 2020).

Obesity, on the other hand, has been identified as an independent risk factor for severe H1N1 lung infection (Van et al., 2011). Furthermore, abdominal obesity is linked to the poor ventilation at the base of the lungs, resulting in lower blood oxygen saturation (Peters and Dixon, 2018). Additionally, aberrant release of adipokines and cytokines such as tumour necrosis factor-alpha and interferon characterizes a persistent low-grade inflammation associated with abdominal obesity, which may obstruct immune response (Huttunen and Syrjanen, 2013) and have consequences on the bronchi and lung parenchyma (Zhang et al., 2018). Overall, it suggests that obesity may be an independent risk factor for SARS-CoV-2 infection (Ryan et al., 2020).

CONCLUSION

Although COVID-19 has affected all age groups but patients with already existing comorbidities are at higher risk of getting severe Covi-19 infection. It has been observed throughout the pandemic that COVID-19 patients having comorbidities such as diabetes, hypertension and Cardiovascular disease had more rates of hospitalization and mortality. These comorbidities increased ventilator complications among aged patients. As the pandemic is still ongoing, the surveillance of the disease and risk factors as well as therapy modalities should be closely observed.

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