PULMONOLOGY

COMMENT

COVID-19 in Brazil

It has been ~4 months since the first case of coronavirus disease 2019 (COVID-19) was reported in Wuhan, China including a total of ~82,000 patients and 3,341 deaths. Until April 14th, 2020, COVID-19 has affected ~1,950,000 patients in 210 countries and territories around the world and 2 international conveyances and caused ~122,000 deaths in 162 countries/territories.[1] However, the epidemiologic data differs across countries. Although China showed the first case and a higher rate of morbidity and mortality than other sites, the number of new cases per day in China has been less than that elsewhere since February 26, 2020. Further studies and continued monitoring are needed to better understand the underlying mechanism of COVID-19. In addition, United States of America (USA) exceeded the number of cases observed in China on March 28th, 2020 with more than 590,000 COVID-19 patients and ~24,000 deaths, followed by Spain (~172,000 patients and ~18,000 deaths), Italy (~160,000 patients and ~20,000 deaths), France (~137,000 patients and ~15,000 deaths), Germany (~130,000 patients and ~3,000 deaths), United Kingdom (~94,000 patients and ~12,000 deaths) and Iran (~75,000 patients and ~4,700 deaths) by April 14th, 2020. Several effective measures including restricting travel from China, controlling the distribution of masks, extensive research of COVID-19 spread, and government efforts to inform and educate the public were aggressively conducted in Taiwan.[2] This is probably the reason why there were only 39 cases (until February 29th, 2020) with a daily cumulative index of one case per day in Taiwan, which was much lower than that of nearby countries, such as Republic of Korea and Japan.[2]

In Brazil, the number of COVID-19 cases is increasing daily and by April 14th, 2020, 23,955 positive cases have emerged. The number of deaths has also increased to 1,361 COVID-19 patients in the country so far. Deaths are mainly located in São Paulo, which is the most populated state in Brazil.

China has managed to greatly reduce the SARS-CoV-2 virus transmission mostly with three effective measures (WHO-China Joint Mission on Coronavirus Disease 2019 (COVID-19)[3]: (a) protect health professionals with personal protective equipment; (b) identify quickly symptomatic patients by real-time polymerase chain reaction (RT-PCR) test and isolate them; (c) identify the patients' close contacts and quarantine them. Italy has different demographics and social behavior than China and other countries like Germany that coped with the higher ratio of infection and it

exceeded the capacity of the health system. Italy showed a lower testing capacity than China and other countries such as Germany during the first weeks of COVID-19 pandemic, but the capacity to perform RT-PCR has improved, giving better epidemiologic data of less severe cases and asymptomatic individuals carrying the SARS-CoV-2 virus in the population. However, as a final scenario, USA has shown the highest number of deaths related with COVID-19.

In Brazil, until April 14th, 2020, the mortality rate was 1,361/23,955 (5.68%). Italy was the first country to reach the mark of ten thousand COVID-19 related deaths as described by Boccia et al.,[4] which showed a 11.90% of mortality (13,155/110,574). As discussed by the authors, some conditions are closely related to the Italian situation such as the size of the aged population (23.1% of citizens from Italy versus 13.5% in Brazil), the presence of concomitant serious diseases such as chronic obstructive pulmonary disease, ischemic heart disease, smoking habit, number of intensive care units (ICUs) beds and sub intensive care beds along with the quality of the health service. In addition, characteristics of COVID-19 disease in Italy highlights the importance of increasing the number of diagnostic tests performed in the population, to encourage more healthy life styles of individuals who are subject to quarantine measures and ICU admittance, raising awareness about the seasonal flu that can maximize the number of patients visiting hospital and reaching the SARS-CoV-2 virus colonization acting as a vector, protecting medical personnel who could contribute to dissemination of the infection and avoiding simultaneous transmission which can cause momentary health system failure.[4]

The experience of dealing with COVID-19 in Brazil may give a new perspective since the country is dealing with many issues at the same time including social, political and genetics (admixed population with high variability at genome level) aspects, as follow:

(i) Brazil has many risk groups as described by World Health Organization (WHO) like those older than 60 years and with prognostic comorbidity, which may occur when diseases predispose the patient to develop severe COVID-19 symptomatology needing intensive care in ICUs. In addition, Brazilian population is comprised of ~500,000 indigenous citizens with a genome composition and a different physiological response from other people and the indigenous genome and its response to SARS-CoV-2 virus infection is not well known. Moreover, the indige-

nous people like the rest of the population, has limited access to hospital for intubation when needed. Also, on April 2nd, the first case of COVID-19 was identified in the indigenous population. Now, Brazil has several indigenous cases with COVID-19 including three deaths: (a) 15-year-old Indigenous Yanomami boy from Roraima State without known previous diseases and/or comorbities; (b) 44-year-old Indigenous Kokama woman from Amazonas State with autoimmune hemolytic anemia; (c) 78-year-old Indigenous Tikuma man from Amazonas State with cardiac disease. The COVID-19 can be devastating for the indigenous population mainly because of their restrictions to access to medical care.

(ii) Brazil is a continental country with a population that is different in each region based on social behavior, genetics (each region has a different level of ancestral contribution of African, Caucasians and Indigenous genomes) and economic backgrounds raising the need for different medical and social managements in each area. All regions in Brazil have already seen COVID-19 cases and there is no medical support for all which takes into consideration particular state characteristics. In addition, Brazil does not have formal data on ICU beds and sub intensive care beds; besides that, the number of beds is distributed between private and public health systems. The number of patients needing the public health system is higher than for private health care. In the early stages of COVID-19 disease, before community infection, the number of hospitalizations in the private system was higher than in public health system conforming with the disease origin and type of infection and its placement. Between the Influenza virus subtype (H1N1) pandemic (2009) and COVID-19, Brazil lost ~34,500 hospital beds. In approximate the number of hospital beds in the country fell approximately from 460,920 to 426,380 in the interval between the two pandemics. The fall occurred in the Unified Health System (SUS), which lost 48,530 service spaces. In the same period, the private health service showed an increase of ~14,000 beds. However, Brazil gained 17,300 (from 42,400 to ~60,000–62,000 thousand) ICU beds in the same period. Brazil's ICUs are concentrated mainly in three states: São Paulo (~18,000 ICUs), Rio de Janeiro (~7,000 ICUs) and Minas Gerais (~6,000 ICUs). Moreover, most of the ICUs are located in the capital cities and in cases of adult ICU, and there is an occupancy rate of beds of ~90%. The WHO recommends 1–3 ICUs beds for every 10,000 inhabitants and Brazil has approximately 1 bed for every 10,000 inhabitants, but the number of ICUs beds is not equally distributed within different regions of Brazil, even including adjustment by the number of inhabitants in each state. In addition, the quantity of equipment such as respirators is scarce, there are, according to the government, ~65,000 respirators available in the country and, interestingly, in the H1N1 pandemic there were just over 35,000. To be noted, the Brazilian Federal Government and the Brazilian Health Ministry recommended the use of Hydroxychloroquine and Chloroquine in cases of COVID-19 after medical indication – the drugs can be used after case by case evaluation, even without scientific proof.

(iii) The studies about COVID-19 and its behavior in a tropical climate are scarce until now and Brazil has this climate with huge amplitude of temperature, air pollution, relative high humidity and environmental factors, which is mainly vegetation cover from north to south, east to west. Maybe, like other tropical countries, Brazil may have a different severity and/or disease progression considering the climate markers as discussed before. In addition, in our country, there is high amplitude of lethality among states varying from zero at Tocantins to 16% at Piauí. Also, São Paulo State represents the State with highest number of cases and a lethality of 6.8%. The lethality index will change after concluding the diagnosis by RT-PCR in mild, severe cases and deaths related with respiratory symptoms close to COVID-19. However, Brazil is testing only severe cases and the total number of patients is underestimated.

(iv) Brazil is formally an admixed population including African, Caucasians and Indigenous features. There is also a variability in the contribution of each offspring by region from the Brazil collaborating with genetic diversity that leads to a wide phenotypic expression. In those cases, the phenotype response to COVID-19 can diverge among regions and, concomitantly, genetics features behind each subpopulation from Brazil.

(v) There is a social and economic disparity among regions corroborating several issues related with COVID-19 pandemic such as availability of diagnostic tests, number of ICUs, access and understanding of information about the disease, and the decisions to control the pandemic.

(vi) Brazil presents great urban low-income conglomerates known as ''favelas'' where many people live in precarious condition with no access to health, social and financial support. Favelas comprise ~3.7% (Federal District) to 53.9% (Belem, capital of Pará) of people in some capitals. In addition, in São Paulo there are ~2 millions of people living in Favelas where the infection can be transmitted and without diagnostic confirmation before or after death. Also, it is estimated that ¼ of Brazilian population in São Paulo state has a poor adhesion to quarantine.

(vii) In Brazil, scientific research has been suffering from reduction in the financial support to research and scholarships. In addition, the Universities, mainly federal and public, experienced a setback in recent years. This whole process confounds the difficulties of dealing with the COVID-19 pandemic because Brazil has many University Hospitals which have financial limitations in terms of performing COVID-19 diagnosis and resources to deal with the disease. Some agencies are now making an effort to investigate COVID-19, but we will have a limited amount of funding for studies in other areas.

(viii) During recent years, the level of education of the Brazilian population has hugely improved; however, the quality is not totally proven. The academic levels corroborate the low understanding about the COVID-19 pandemic and the importance of social changes such as self-isolation at home.

(ix) Throughout the whole country there has only been genetic diagnosis in cases of severe COVID-19, leading therefore, to a very high number of undiagnosed patients. The undiagnosed patients relate to a higher

index of infection and dissemination within the population which negatively affects disease control, postpones quarantine, and has further negative effects on the economy. The use of RT-PCR to confirm the disease may be the best choice for isolating confirmed patients and giving time to treat severe patients at UTIs. In this context, the main issue in treating COVID-19 is when to start the treatment and to isolate the patients with positive RT-PCR even in the absence of clinical symptoms such as fever and cough. The country is not able to treat all patients correctly at the same time and due to that, Brazil is going through the first stages of the infection. Health professionals are worried about the next steps since the country is recording higher numbers of cases every day. Also, during the month of March, April and May, emerging new cases of bronchiolitis at pediatric age which need treatment, interventions and hospitalizations; in addition, the H1N1 and Dengue, both are a continuous health problem.

(x) In Brazil, as widely publicized in the media and declared in official interviews, the Brazilian Federal Government declared the need for a vertical quarantine model to mitigate the economic impact, highlighting an underestimation of the COVID-19 pandemic. There were some official declarations after a presidential visit to the American President Donald Trump accompanied by 20 individuals from Brazilian delegation, who were later diagnosed positive to COVID-19. At that time, some public demonstrations took place in favor of the Federal Government behavior. Despite that opportunity, members of the government did not agree with quarantine and greeted voters in front of the Republican Palace.

On March 29th, 2020, members of the government visited public places mitigating the measures stipulated by the Ministry of Health. Also, the Government included as a campaign measure the hashtag #OBrasilNãoPodeParar (#BrazilCannotStop). The campaign was removed from official media and the Government denied the disclosure of the advertisement.

The discordance between the members of government's speeches including the follow main issues: the efficacy of Hydroxychloroquine and Chloroquine and its use to treat COVID-19, the need to quarantine all citizens instead of restrictions for risk groups only, the severity of the COVID-19 disease and its capacity for dispersion among people, the beliefs about the exclusively affecting patients above 60 years old or with a comorbidity, quarantine as a measure to postpone the number of infected patients vs. avoiding the infection.

The Brazilian Health Ministry and the media are providing enough data, information and education for the public about the pandemic. Moreover, the population has a low adhesion to quarantine and Ministry Health recommendations. This may contribute to higher infection rates, high demand for ICUs and general collapse in health with many deaths that could be avoided. Brazilian population should have learned from Italy and other countries with high number of cases and lethality[5]; however, Brazil is heading toward an uncertain future.

As described by Boccia et al.,[4] Brazil should at least follow the lessons from Italy: ''(1) avoid admitting patients with suspected SARS-CoV-2 infection to the hospital, except when they clearly require hospital care; (2) maintain strict hygienic procedures in the hospital environment; and (3) act swiftly in case of exposure of medical personnel to avoid the loss of personnel capacity.'' Until now, Brazil is learning to follow the lessons. In addition, as discussed by Froes, we need to update our action plans and to learn from our mistakes during the pandemic.[6] Now, we are suffering the effects of the COVID-19 disease – the third global outbreak of coronavirus disease in the 21st century – and we cannot overestimate the potential of infectious diseases to change our habits as human living as civilization, but we can optimize the diagnosis time and efficacy, to achieve better adherence to infection control measures, to improve therapeutic and preventive options and to reduce the exposure to infectious agents such as SARS-CoV-2 virus.[6]

In conclusion, the SARS-Cov-2 virus cannot be allowed to insert itself among us and be just another agent responsible for the flu, because it has very high rates of transmission and its case-fatality is not low.[7] Further studies and continued monitoring are needed to better understand the underlying mechanism of COVID-19. In part, the Brazilian society is going along with the quarantine, but there is pressure from the Federal Government to return everyone who has been in vertical isolation. In addition, COVID-19 pandemic highlights the importance of Science, education and support for scientific advance. Science is the key to solving many problems; however, that key should be professionally used by society and government in order to resolve difficult and challenging situations.

Authors' contributions

All authors have approved the manuscript and agreed with its submission to the journal. Also, FALM and MMO wrote and revised the manuscript.

Conflict of interest

None declared.

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Sleep labs, lung function tests and COVID-19 pandemic – Only emergencies allowed!

Respiratory tract infections remain the top cause of morbidity and mortality worldwide from infectious diseases.[1] In January 2020, a novel coronavirus was identified, from the respiratory tract secretions of patients in China,[2–4] due to whole-genome sequencing. The disease was named COVID-19 (Corona-VIrus DIsease-2019) by the World Health Organization (WHO).[4] Afterwards, different investigation and research was undertaken and evidence was provided on human-to-human transmission in community, household and hospital settings.[5,6] Guidelines and recommendations were developed worldwide about prevention, diagnosis, control and management of COVID-19.

Public health measures targeting community infection control remain of primary importance and are still the only ones capable of buying time, flattening the infection incidence curve and causing a dramatic change in the course of the outbreak. Mankind has to make sustained and responsible changes in behaviour.[7] There still remain many unanswered questions concerning infection control measures inside the hospitals and clinics. In epidemic or pandemic situations like the one we are living through, sleep labs can configure increased risk of infection for patients and health care professionals and to the best of our knowledge, guidelines in this field are lacking.

Furthermore, patients under nocturnal ventilatory support including non invasive ventilation (NIV) combine an intrinsic high risk for respiratory infections and related complications and a very high potential risk of infection for care givers because of the high burden of droplets created by the ventilators (8). In fact, NIV using a vented mask in patients with acute respiratory failure can disseminate large droplets up to a distance of 1 m.[8]

Polysomnography level I (PSG I), the gold standard for sleep disorders breathing (SDB) diagnosis, takes place in sleep labs worldwide, using specific beds and under direct supervision of a sleep technician. Also PSG level II (domiciliary unsupervised) and PSG level III (domiciliary cardio respiratory study) are commonly performed. All these diagnostic approaches carry infection risks and in a pandemic situation, especially in the mitigation or suppression phases/strategies, sleep labs should no longer be working on diagnosis.

The belts used to fix the equipment to patients pyjamas or to patients' underwear are made of textile fibres which disable its disinfection. Also the manufacturers of the polysomnographers do not recommend them to be sanitized due to possible damage. So, this equipment is not safe to use in hospital or in patients' homes. Testing to clarify what kind of disinfection this equipment does resist without losing capability, and most of all, development of equipment that can be effectively disinfected in cases of respiratory infection due to highly contagious microorganisms are urgently needed.

At this point in this pandemic, sleep labs should avoid performing polysomnographies unless for hospitalized, acutely ill patients with a high probability of sleep disordered breathing that will impact negatively on the underlying disease(s). The equipment used in infected patients should undergo a quarantine period according to the material used by its manufacturer.

The working team of a sleep lab consisting of physicians, sleep technicians and respiratory physiotherapists or respiratory nurses should receive training in updated clinical knowledge of the COVID-19 pandemic, prevention tools and guidelines from the government, scientific societies and national authorities. Updates on this information should be provided as needed. Measures of prevention, protection and screening have been shown to be efficient in other settings.[9]

The healthcare team should respect some recommendations:

- check body temperature on arrival and departure to/from the sleep lab
- inform team leader if patient is presenting with *de novo* respiratory symptoms or in contact with a case
- use personal protective equipment (facial mask and gloves)
- use full personal protective equipment when dealing with confirmed cases of infection (protective gown, gloves, facial mask, goggles and cover boots)
- perform hand hygiene on arrival and departure from sleep lab and whenever needed