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# Risk factors for SARS-CoV-2 infection and epidemiological profile of Brazilian anesthesiologists during the COVID-19 pandemic: cross-sectional study

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**KEYWORDS**
COVID-19;
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**Abstract**
*Introduction:* The devasting effects of COVID-19 have caused economic and health impacts worldwide. Anesthesiologists were one of the key professionals fighting the pandemic and have been highly exposed at their multiple sites of clinical practice. Thus, the importance of determining the nature of the infection in this population that provides care to SARS-CoV-2 patients.
*Method:* We conducted a cross-sectional study administering an online questionnaire to examine the demographic and epidemiological profile of these professionals in Brazil, and to describe the risk factors for viral infection during the pandemic.
*Results:* A total of 1,127 anesthesiologists answered the questionnaire, 55.2% were men, more than 90% with age below 60 years, with infection and reinfection rates of 14.7% and 0.5%, respectively, and 47.2% reported a significant income reduction. The predictors of COVID-19 contamination were practicing in operating rooms (OR = 0.42; 95% CI 0.23–0.78), direct contact with infected patients (OR = 5.74; 95% CI 3.05–11.57), indirect contact with infected patients (OR = 2.43; 95% CI 1.13–5.33), working in a pre-hospital setting (OR = 2.36; 95% CI 1.04–5.03), and presence of immunosuppression, except for cancer (OR = 4.89; 95% CI 1.16–19.01).
*Conclusion:* COVID-19 had enormous consequences on Brazilian anesthesiologists regarding sociodemographic aspects and contamination rates (5.57 times higher than in the general population). These are alarming and unprecedented findings for this professional group, as they reveal the considerable risk of infection and its independent predictor variables.


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## Introduction

In December 2019, COVID-19, a flu-like illness caused by the SARS-CoV-2 virus, emerged in Wuhan (China) and rapidly circulated worldwide, causing a massive number of infected people and deaths.[1,2]

COVID-19 is highly contagious and predominantly transmitted by droplets. It causes variable degrees of inflammatory response in the respiratory tract of the host, that can be associated with severe morbidity and death in patients with underlying diseases such as Hypertension, Diabetes Mellitus (DM), respiratory disorders, immunosuppression, and age over 60 years.[3]

Since the WHO acknowledged the pandemic on March 11, 2020, several health measures have been adopted by governments, mainly aimed to reduce the transmissibility and the stress on health systems caused by the high number of patients requiring hospital admission, frequently in Intensive Care Units (ICU) for invasive ventilatory support. Brazil was one of the countries most affected by the pandemic, with more than 5 million cases and 155,000 deaths as of October 2020.[4,5]

Anesthesiologists have played a key role in COVID-19 patient care, given their skills in airway management and role in intensive care units.[6] In Brazil, there is a wide-range spectrum of performance of anesthesiologists, from the site where they practice (region of the country, type of sector [operating suite, pre-hospital, intensive care, etc.]), resource availability logistics, public and/or private facility, among others. Anesthesiologists also exhibit great variability in epidemiological profiles (gender, color/ethnicity, age, time since graduation, underlying diseases, etc.). Such features can be related to differences in susceptibility to COVID-19, and the epidemiological mapping and identification of infection risk factors (modifiable or not) are essential components for designing protection strategies for these health professionals, who are highly exposed during a pandemic. It is also worth underlining the extent of the financial, welfare, professional, occupational, and physical and mental health impacts to anesthesiologists, which helped develop action strategies by regional and federal societies of Anesthesiology.[7]

In face of this disturbing scenario, the present study aimed to assess the sociodemographic profile, and determine the prevalence of infection and the risk factors for infection by COVID-19 in the population of anesthesiologists practicing in Brazil.

## Methods

The study was submitted to the Research Ethics Committee of Hospital Israelita Albert Einstein (São Paulo) and after its approval (4.017.866), a cross-sectional observational study was performed following the principles of the Declaration of Helsinki (2013). Between June and July 2020, an electronic questionnaire was sent by e-mail and social media, targeting to reach the population of Brazilian anesthesiologists as widely as possible (absolute number of 25,484 professionals, according to demographic data from the Federal Council of Medicine and University of São Paulo).[8] The analysis included all anesthesiologists who answered the questionnaire and who consented to the Informed Consent Form and the Confidentiality Term provided digitally.

The questionnaire comprised 23 questions (structured data). Data were collected by non-probabilistic sampling (convenience sampling) during the months of June and July 2020, the most critical moment of the pandemic in Brazil. After this period, collection was discontinued, and we started data analysis. A priori calculation of sampling power was not performed, given the lack of knowledge and inaccuracy of information in the literature on COVID-19 and potential risk factors for infection by SARS-CoV-2.

The identity of study participants was protected, and participants were identified in the database only by sequential numbers for answers in the questionnaire. All data were collected and stored on Google Forms®, protected by password. All questions were compulsory, and participants were not able to complete the questionnaire if there were incomplete answers. All study variables were categorical in order to prevent completion errors due to mistyping or inadvertent insertion of outliers. To deter duplication of participants, the electronic mail (e-mail) was registered at the time the questionnaire was joined, ensuring that each participant answered questions only once, since the software recognized the email registered during access.

The strategy to increase the number of respondents consisted of weekly launching of the survey questionnaire via social media (Facebook®, Instagram®, Whatsapp®, Telegram®) in groups of anesthesiologists and sending it to the email of all anesthesiologists listed in their medical societies, during the study collecting period.

Access to the database was granted only to the statistician and administrative assistant not linked to the study.

The variables studied were: age, sex, ethnicity, time practicing anesthesiology, Brazilian region of practice, type of facility in which the anesthesiologist practiced (public and/or private), percentage of income reduction, infected or not by COVID-19 (we considered infected only participants who reported positive laboratory tests, serological tests or PCR test), symptoms presented, time started treatment after onset of symptoms, requirement of hospital admission and care unit, need and length of leave of absence, criteria used for resuming medical activities, PPE worn (personal protective equipment), PPE type worn, frequency PPE worn, report of care for patients with infection, care site, use of video laryngoscope, presence of difficult tracheal intubation, tracheal intubation failure requiring positive pressure ventilation, presence of reinfection of the anesthesiologist, type of therapeutic drugs received by infected anesthesiologist, occurrence of comorbidities, presence of pregnancy and use of anticoagulant medications.

Given the categorical nature of the study variables, data were described as frequencies and analyzed using the Fisher's exact test. Afterwards, a logistic regression model was performed (logit binding factor, binomial distribution), with the fact of having had or not COVID-19 diagnosed in laboratory (PCR and/or serology) as the dependent variable.

Variables showing $p < 0.1$ for the association tests were candidates for entry into the regression model. Next, predictors were selected using the forced entry method, based on the likelihood ratio. Variables that caused a decrease in the Akaike Information Criterion (AIC) in their models were progressively separated. Next, the variables selected were time practicing anesthesiology, region of predominant practice, type of facility where practice was developed, contact with SARS-CoV-2, pre-hospital setting practice, operating suite practice and presence of immunosuppression (except cancer), for building seven more logistic models, based on their individual and sequential addition, in the order mentioned. It became evident in the process that the model that best explained the variance of our data was the one that included all the variables highlighted above, having the lowest possible values of AIC and residual Deviance as criteria.

The Wald test was implemented for coefficients, as well as the respective degrees of freedom. Multicollinearities were verified and discarded (VIF [variance inflation factor], 1/VIF). The statistical significance level adopted was an $\alpha$ value of 0.05.

For statistics analysis, R, version 4.0.2 was the software used (https://www.r-project.org).

## Results

The total number of participants was 1,127 anesthesiologists. The population was predominantly comprised by men (55.2%) and participants under the age of 60 years (90.51%). Monthly income reduction above 40% was reported by 47.2% of participants, a fact that reflects the large reduction in surgical/diagnostic volume during the pandemic, as well as loss of income due to leave of absence for health reasons. In the study population, the prevalence of infection by COVID-19 was 14.7%, from the beginning of the pandemic to the end of data collection. Among the 166 COVID-infected participants, the rate of laboratory-confirmed reinfection was 3.6%, that is, 6 participants.

The main symptoms among infected participants were asthenia (9.3%), dry cough (8.6%), hypo/anosmia (8.4%), myalgia/arthralgia (8.3%), odynophagia (7.4%), rhinorrhea (6.5%), nasal obstruction (6.2%), fever (6%), diarrhea (5.7%), and neurological symptoms such as dizziness, headache, and paresthesia (4.9%).

The medications most used by anesthesiologists during the period of the study were Vitamin D (31.3%), Vitamin C (27.7%), Zinc (22.4%) and Dipyrone (20.5%). The rate of using the drugs widely discussed in the media such as Ivermectin, Azithromycin and Hydroxychloroquine were 13%, 7.5% and 5.8% respectively. Corticosteroids and anticoagulants were used by 4.7% and 2.8%, respectively.

Regarding the criteria used for resuming clinical practice after laboratory-confirmed infection, 69.8% of participants adopted only improvement of symptoms as a parameter, and 30.2% based the decision on laboratory criteria (CRP and/or serology).

Tables 1 to 5 describe association tests for each variable analyzed regarding SARS-CoV-2 infection with their respective *p*-values.

Table 1 depicts demographic and clinical data.

Table 2 describes PPE worn by anesthesiologists. Overall, 28.57% of participants had partial or inadequate availability of PPE, but this did not result in a statistically significant association with COVID-19 infection, or when PPE was assessed separately.

Table 3 shows the different sites where anesthesiologists practiced during the study period and data related to airway management. It is noteworthy that 29.1% of the participants had to manage at least one case of difficult airway.

Table 4 shows which drugs were used by anesthesiologists for the treatment and/or prevention of COVID-19 and whether there was an association with SARS-CoV-2 infection.

Table 5 reveals the prevalence of comorbidity among participants and the association with COVID-19 infection.

Independent predictors of SARS-CoV-2 infection were obtained by a logistic regression model and listed in Table 6.

## Discussion

To our knowledge, this is the first study designed to detect risk factors for SARS-CoV-2 infection specifically in a population of anesthesiologists nationwide.[8] The prospecting and analysis of these data offer a relevant contribution to the understanding of this serious health issue in this specialty, particularly exposed to infection and with a highly active role in the pandemic nationwide.

Anesthesiologists were often the specialists chosen to perform Orotracheal Intubation (OTI) in patients with COVID-19 due to their airway management skills, thus explaining the high viral contamination observed. Despite the overall infection rate of 2.64%[4] in the Brazilian population, the prevalence of coronavirus infection in the participants of the present study was 5.57 times higher, that is 14.7%, and it reflects the high exposure and risk of infection among anesthesiologists.[4]

El-Boghdadly et al. reported similar results and reported a 10.7% infection rate when they assessed the risk of infection among healthcare professionals after participating in OTI of patients infected with the virus.[9] In the United States, Morcuende et al. performed an analogous study administering a questionnaire via e-mail. They reported an incidence of symptoms of 26.2% in anesthesiologists and intensivists after occupational exposure to the virus. The high incidence reported can be explained by the design of their study, which assessed the presence of symptoms and not only cases confirmed by serology and/or PCR.[10] A Canadian study published in April 2020 identified anesthesiology as one of the specialties in which most doctors died from COVID-19.[11] However, to date, mortality data for anesthesiologists are still scarce.[1,10,12–14]

Among our study participants who had SARS-CoV-2 infection, we reported the rate of reinfection confirmed by laboratory tests of 3.6% (6 participants), an observation that has already been reported in the literature and that has raised concerns of health authorities worldwide.[15]

No sociodemographic variables analyzed in our regression model proved to be independent predictors for risk of infection by COVID-19. Similarly, Leeds et al. were not able to associate parameters such as gender, age, and ethnicity with an increased risk of developing COVID-19.[16]

The fact that more than 25% of respondents did not have access to full PPE reflects heterogeneity of protocols and budgets among different services and geographic regions, or even individual/institutional negligence during the pandemic. Paradoxically, there was no association between low adherence to full PPE and contamination by SARS-CoV-2. This can be explained perhaps by the lower incidence of contact with infected patients in the group of anesthesiologists with

**Table 1** Demographic and clinical characteristics.

| | SARS-CoV-2 infected subjects, n (%) | SARS-CoV-2 not-infected subjects, n (%) | *p*[a] |
|---|---|---|---|
| | 166 (14.7) | 961 (85.3) | |
| **Age in years** | | | |
| 20 to 29 | 16 (9.6) | 80 (8.3) | 0.55 |
| 30 to 39 | 70 (42.1) | 344 (35.8) | 0.12 |
| 40 to 49 | 41 (24.7) | 243 (25.3) | 0.92 |
| 50 to 59 | 26 (15.8) | 200 (20.8) | 0.14 |
| 60 to 69 | 13 (7.8) | 80 (8.3) | 1 |
| 70 and + | 0 (0) | 14 (1.5) | 0.24 |
| **Sex** | | | |
| Female[b] | 79 (47.6) | 426 (44.3) | 0.45 |
| Male | 87 (52.4) | 535 (55.7) | |
| **Color/Ethnicity** | | | |
| Yellow | 5 (3.0) | 52 (5.5) | 0.25 |
| White | 131 (78.9) | 731 (76.0) | 0.49 |
| Black | 2 (1.2) | 20 (2.1) | 0.76 |
| Brown | 28 (16.9) | 158 (16.4) | 0.91 |
| **Time practicing anesthesiology** | | | |
| M.E. | 12 (7.2) | 60 (6.2) | 0.6 |
| ≤5 years | 51 (30.7) | 192 (20.0) | 0.003 |
| 6 to10 years | 22 (13.3) | 156 (16.2) | 0.36 |
| 11 to 15 years | 11 (6.6) | 140 (14.6) | 0.004 |
| 16 to 20 years | 25 (15.1) | 95 (9.9) | 0.06 |
| ≥21 years | 45 (27.1) | 318 (33.1) | 0.12 |
| **Predominant region of practice** | | | |
| North | 5 (3.0) | 26 (2.7) | 0.8 |
| Northeast | 40 (24.1) | 156 (16.3) | <0.01 |
| Center-West | 11 (6.6) | 79 (8.2) | 0.8 |
| South | 9 (5.5) | 143 (14.9) | <0.001 |
| Southeast | 101 (60.8) | 557 (57.9) | 0.49 |
| **Type of facility** | | | |
| Public | 26 (15.7) | 92 (9.6) | 0.02 |
| Private | 28 (16.8) | 277 (28.8) | 0.001 |
| Public & private | 112 (67.5) | 592 (61.6) | 0.01 |
| **Income reduction** | | | |
| No reduction | 31 (18.7) | 122 (12.7) | 0.01 |
| ≤20% | 19 (11.4) | 98 (10.2) | 0.48 |
| 21% to 30% | 29 (17.5) | 123 (12.8) | 0.11 |
| 31% to 40% | 20 (12.0) | 153 (15.9) | 0.24 |
| 41% to 50% | 36 (21.7) | 176 (18.4) | 0.33 |
| ≥50% | 31 (18.7) | 289 (30.0) | 0.002 |
| **Level of care** | | | |
| Home | 160 (96.4) | 957 (99.5) | 0.001 |
| Ward | 1 (0.6) | 3 (0.3) | 0.47 |
| High-dependence unit | 1 (0.6) | 1 (0.2) | 0.27 |
| ICU | 4 (2.4) | 0 (0) | <0.001 |
| **Oxygen therapy** | | | |
| Not required | 162 (97.6) | 961 (100) | < 0.001 |
| Nasal cannula | 1 (0.6) | 0 (0) | 0.15 |
| TI/CMV | 3 (1.8) | 0 (0) | 0.003 |
| **Leave from work** | | | |
| No | 23 (13.9) | 883 (91.9) | <0.001 |
| ≤7 days | 11 (6.6) | 21 (2.2) | 0.004 |
| 8 to 14 days | 80 (48.2) | 18 (1.9) | <0.001 |
| 15 to 21 days | 40 (24.1) | 4 (0.4) | <0.001 |

Table 1 (*Continued*)

| | SARS-CoV-2 infected subjects, n (%) | SARS-CoV-2 not-infected subjects, n (%) | $p^a$ |
|---|---|---|---|
| ≥21 days | 12 (7.2) | 35 (3.6) | <0.001 |
| **SARS-CoV-2 contact** | | | |
| None | 18 (10.8) | 262 (27.3) | <0.001 |
| Indirect | 20 (12.0) | 163 (17.0) | 0.1318 |
| Direct | 128 (77.2) | 536 (55.7) | <0.001 |
| Red blood cell concentrate | 6 (3.6) | 7 (0.7) | 0.006 |
| Pregnancy | 2 ((10) | 77 (18.8) | 0.75 |

M.E., Physicians under specialization; PPE, Personal Protection Equipment; TI/VMV, Tracheal Intubation/controlled Mechanical Ventilation; ICU, Intensive Care Unit.
[a] Fisher's exact test.
[b] Reference category.

**Table 2** PPE.

| | SARS-CoV-2 infected subjects n (%) | SARS-CoV-2 not-infected subjects n (%) | $p^a$ |
|---|---|---|---|
| | 166 (14.7) | 961 (85.3) | |
| **PPE Availability** | | | |
| Yes | 123 (74.0) | 682 (70.9) | 0.75 |
| No | 5 (3.0) | 20 (2.1) | 0.39 |
| Partially | 38 (22.3) | 259 (26.7) | 0.29 |
| **Protection offered by PPE (perception)** | | | |
| Very little | 14 (8.4) | 35 (3.6) | 0.01 |
| Little | 17 (10.2) | 114 (11.8) | 0.6 |
| Satisfactory | 106 (63.8) | 619 (64.4) | 0.9 |
| Very satisfactory | 29 (17.4) | 193 (20.1) | 0.08 |
| **Protection offered by PPE (quantity)** | | | |
| Very few | 15 (9.0) | 43 (4.5) | 0.02 |
| Few | 27 (16.3) | 150 (15.6) | 0.73 |
| Satisfactory | 92 (55.4) | 573 (59.6) | 0.34 |
| Very satisfactory | 32 (19.3) | 195 (20.3) | 0.03 |
| **PPE frequency** | | | |
| Did not wear | 2 (1.2) | 19 (1.9) | 0.75 |
| SARS-Cov-2 positive | 8 (4.8) | 28 (2.9) | 0.22 |
| SARS-CoV-2 positive and suspected cases | 69 (41.5) | 312 (32.4) | 0.02 |
| All cases | 87 (52.4) | 602 (62.6) | 0.01 |
| **Reasons for not wearing PPE** | | | |
| Unavailable | 18 (10.8) | 95 (9.9) | 0.67 |
| Negligence | 10 (6.0) | 53 (5.5) | 0.71 |
| Negligence and unavailable | 118 (71.0) | 671 (69.8) | 0.78 |
| PPE always worn | 20 (12.0) | 142 (14.8) | 0.4 |
| Acrylic tent | 94 (56.6) | 588 (61.2) | 0.3 |
| Gloves | 165 (99.4) | 950 (98.8) | 1 |
| **Waterproof apron** | 164 (98.8) | 931 (96.8) | 0.21 |
| **Acrylic protection goggles** | 162 (97.6) | 939 (97.7) | 0.78 |
| **N95/PFF2/PFF3 Masks** | 165 (99.4) | 949 (98.7) | 0.7 |
| **Surgical mask** | 157 (94.6) | 924 (96.1) | 0.39 |
| **Cap** | 164 (98.8) | 942 (98.0) | 0.75 |
| **Face Shield** | 165 (99.4) | 942 (98.0) | 0.34 |

PPE, Personal Protection Equipment.
[a] Fisher's exact test.

less availability of protection resources. However, such a hypothetical explanation and cannot be verified by our data. Also, the absence of association between different types of PPE and COVID-19 can be understood by the complex and multifactorial nature of viral transmission. Thus, we could have variables not evaluated by our study design that would explain this finding.

Practicing in the operating room seems to be a protective activity regarding the risk of acquiring the disease. This finding can be explained by the adoption of protocols of

**Table 3** Anesthesiologists' sites of practice and airway management.

| | SARS-CoV-2 infected subjects, n (%) | SARS-CoV-2 not-infected subjects, n (%) | *p*[a] |
|---|---|---|---|
| | 166 (14.7) | 961 (85.3) | |
| **Outpatient clinic** | 5 (3.0) | 28 (2.9) | 1 |
| **Field hospital** | 15 (9.0) | 28 (2.9) | 0.001 |
| **PHC** | 10 (6.0) | 9 (0.9) | < 0.001 |
| **Endoscopy** | 45 (27.1) | 166 (17.3) | 0.003 |
| **Other imaging sectors** | 71 (42.7) | 262 (27.3) | < 0.001 |
| **ER** | 25 (15.0) | 111 (11.5) | 0.19 |
| **ICU** | 78 (46.9) | 291 (30.3) | < 0.001 |
| **Surgical Suite** | 129 (77.7) | 619 (64.4) | < 0.001 |
| **Video laryngoscope** | | | |
| All cases | 38 (22.9) | 248 (25.8) | 0.49 |
| Only for SARS-Cov-2 | 17 (10.2) | 128 (13.3) | 0.31 |
| Not used | 111 (66.8) | 585 (60.8) | 0.16 |
| **Difficult airways** | 66 (39.7) | 262 (27.2) | 0.001 |
| **TI failure + manual ventilation** | 19 (11.4) | 80 (8.3) | 0.18 |

ICU, Intensive Care Unit; PHC, Prehospital Care; TI, Tracheal Intubation.
[a] Fisher's exact test.

**Table 4** Drugs administered (most common used drugs for SARS-CoV-2 treatment).

| | SARS-CoV-2 infected subjects, n (%) | SARS-CoV-2 not-infected subjects, n (%) | *p*[a] |
|---|---|---|---|
| | **166 (14.7)** | **961 (85.3)** | |
| **Anticoagulants** | | | |
| Prophylactic[b] | 7 (4.2) | 10 (1.0) | 0.01 |
| Therapeutic | 6 (3.6) | 8 (0.8) | |
| **BCG** | 4 (2.4) | 3 (0.3) | 0.01 |
| **Sarilumab** | 3 (1.8) | 0 (0) | 0.003 |
| **Tocilizumab** | 6 (3.6) | 0 (0) | 0.001 |
| **Favipiravir** | 3 (1.8) | 0 (0) | 0.003 |
| **Interferon-$\alpha$-2B** | 5 (3.0) | 0 (0) | 0.001 |
| **Remdesivir** | 5 (3.0) | 0 (0) | 0.001 |
| **Convalescence plasma therapy** | 6 (3.6) | 0 (0) | 0.001 |
| **Lopinavir/Ritonavir** | 4 (2.4) | 1 (0.1) | 0.002 |
| **Vitamin C** | 62 (37.3) | 249 (25.9) | 0.003 |
| **Vitamin D** | 6 (3.6) | 86 (8.9) | 0.02 |
| **Zinc** | 51 (30.7) | 201 (20.9) | 0.006 |
| **Azithromycin** | 60 (36.1) | 37 (3.8) | 0.001 |
| **Other antibiotics** | 14 (8.4) | 16 (1.6) | 0.001 |
| **Ivermectin** | 33 (19.8) | 112 (11.6) | 0.005 |
| **Hydroxychloroquine** | 32(19.3) | 27 (2.8) | 0.001 |
| **Chloroquine** | 2(1.2) | 1 (0.1) | 0.058 |
| **Corticoids** | 27 (16.3) | 26 (2.7) | 0.001 |
| **Oseltamivir** | 10 (6.0) | 6 (0.6) | 0.001 |
| **Non-steroid anti-inflammatory drugs** | 21 (12.7) | 63 (6.5) | 0.009 |
| **Dipyrone** | 101 (43.9) | 129 (56.1) | 0.001 |
| **Paracetamol** | 37 (60.8) | 46 (4.8) | 0.001 |

BCG, Calmette-Guérin vaccine.
[a] Fisher's exact test.
[b] Reference category.

temporary deferment of elective surgeries and testing of patients who had to undergo subsequent elective surgeries,[7] and due to the segregated flow of care for SARS-CoV2 infected patients. Such measures may have ensured a safer environment in relation to virus transmission in the operating room.

Conversely, our study shows that working in Prehospital Care (PHC) was associated with a greater chance of infection among professionals, with OR = 2.36. The prehospital setting is a challenging place for the health professional. Equipment is generally less available, and patients often present in severe clinical status, either due to clinical or trauma condi-

**Table 5** Comorbidities.

| | SARS-CoV-2 infected subjects, n (%) | SARS-CoV-2 not-infected subjects, n (%) | p[a] |
|---|---|---|---|
| | 166 (14.7) | 961 (85.3) | |
| Hypertension | 25 (15.0) | 146 (15.2) | 1 |
| **Diabetes mellitus** | 12 (7.2) | 39 (4.0) | 0.1 |
| **Cardiopathies** | 11 (6.6) | 34 (3.5) | 0.08 |
| **Dyslipidemia** | 22 (13.2) | 88 (9.2) | 0.11 |
| **Obesity (BMI > 30)** | 21(12.6) | 87 (9.1) | 0.15 |
| **Asthma** | 21(12.6) | 98 (10.2 | 0.33 |
| **COPD** | 5 (3.0) | 4 (0.4) | 0.004 |
| **CRF** | 6 (3.6) | 2 (0.2) | < 0.001 |
| **Cancer** | 0 (0) | 9 (0.9) | 0.3 |
| **Immunosuppression (except for cancer)** | 6 (3.6) | 3 (0.3) | < 0.001 |
| **Chronic alcohol consumption** | 6 (3.6) | 7 (0.7) | 0.006 |
| **Smoking** | 7 (4.2) | 32 (3.3) | 0.49 |
| **No comorbidity** | 103 (62.0) | 579 (60.2) | 0.73 |

BMI, Body Mass Index; COPD, Chronic Obstructive Pulmonary Disease; CRF, Chronic Renal Failure.
[a] Fisher's exact test.

**Table 6** Predictors of SARS-CoV-2 infection, according to the logistic regression model.

| | B (SE) | OR | 95% CI | p |
|---|---|---|---|---|
| **Intercept** | -2.4 (0.58) | 0.1 | (0.02–0.27) | < 0.001 |
| **Surgical suite practice** | -0.86 (0.31) | 0.4 | (0.23–0.78) | < 0.01 |
| **Direct contact with infected patients** | 1.74 (0.34) | 5.74 | (3.05–11.57) | < 0.001 |
| **Indirect contact with infected patients** | 0.88 (0.39) | 2.43 | (1.13–5.33) | < 0.05 |
| **Practicing with APH** | 0.86 (0.39) | 2.36 | (1.04–5.03) | < 0.05 |
| **Immunosuppressed (except for cancer)** | 1.58 (0.69) | 4.89 | (1.16–19.01) | < 0.05 |

Observations: $R^2$0.095 (Hosmer-Lemeshow), 0.075 (Cox-Snell), 0.133 (Nagelkerke): $\chi^2(16) = 87.38$.
B, Regression Coefficient; SE, Standard Error; OR, Odds Ratio; 95% CI, 95% Confidence Interval (lower limit – upper limit).

tions, requiring vital-sign stabilization with few resources, and under time pressure for definitive treatment.[17,18] We assume that anesthesiologists submitted to this clinical setting may have been highly exposed to the virus, and were wearing less protection. Another possible factor associated with this finding would be the scarce availability of COVID-19 tests and absence of precaution/knowledge of participants regarding the disease at the time data were collected, compared to later in the pandemic.

Both direct and indirect contact with patients known to be infected increased the chance of anesthesiologists acquiring the disease by nearly 5.7 and 2.4 times, respectively. Our findings are supported by a cohort study carried out in the United States and United Kingdom that revealed that health professionals working on the front line reported higher rates of infection when compared to the general population.[12] An interesting finding was the high risk of infection observed in professionals that reported only indirect contact. This fact reveals that the presence of the virus in theoretically safe environments can represent an important infection factor.

Immunosuppression (apart from cancer) was the only comorbidity reported as risk predictor for virus infection. Although several comorbidities such as diabetes, hypertension and obesity are mentioned in the literature as risk factors for worse outcome in patients who develop the disease,[3,19,20] there are scarce data about which characteristics make patients more susceptible to the virus infection. Therefore, further prospective studies are required to address this issue.

Due to the inaccuracy of information on the purpose of prophylactic and/or therapeutic use of drugs (Table 5), their time of use, dosage, and the empiricism of their use, we considered it prudent to exclude these variables from the regression model, even with a $p < 0.1$. Thus, disclosing biased and inaccurate results was avoided, limiting ourselves exclusively to report descriptive data and the association with COVID-19 infection.

Further examination of our study enabled us to perceive the reduced use of corticosteroids (4.7%), that is one of the few classes of drugs with recently proven efficacy in the treatment of COVID-19.[21,22] Anticoagulants, also widely used to support infected patients,[23] had only a 2.75% use.

Studies show that the prevalence of difficult airway in emergency patients ranges from 9% to 12%.[24–27] Considering that anesthesiologists are professionals trained in airway management, it is surprising that 29.1% of participants reported at least one case of difficult airway. Some hypotheses can be pondered to justify this finding: OTI performed outside the operating room (an environment where anesthesiologists feel less at ease); stress imposed by the pandemic; fear of contamination; urgency and patient severity. These factors would create a more adverse and stressful scenario for airway management, which could lead even the most trained professionals to neglect basic steps of OTI optimization, increasing the challenge of the procedure.

Concerning the limitations of the study, one can name the observational cross-sectional design, which would prevent the control of many variables, including the unobservable ones. Another issue related to the timing of our study is the possibility of contamination by SARS-CoV-2 after answering the questionnaire. Also on this topic, there is a limitation in the diagnosis of new cases of COVID-19, a fact that may have underestimated the incidence of the condition in our sample, as well as the rates of reinfection.

We also underscore that our results are exploratory in nature, devoid of sufficiently robust inference for causality, when compared to controlled and randomized clinical trials.

Another limiting issue was classifying data into categories. This fact can lead to loss of information in the collection and analysis process, despite increasing respondent participation by simplifying the questionnaire and avoiding outliers or typing errors while filling out answers.

## Conclusion

Our findings demonstrate a particular epidemiological profile in the population of anesthesiologists during the COVID-19 pandemic. They also reveal several points of potential care and occupational improvement, in addition to generating future hypotheses, especially in terms of exposure and protection of these professionals, considering the potential risk factors for SARS-CoV-2 infection.

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## Conflicts of interest

The authors declare no conflicts of interest.

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