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ORIGINAL ARTICLE

Assessment of the first 100 deaths from COVID-19 and in-hospital transmission, a neglected risk at the beginning of the pandemic

Avaliação dos primeiros cem óbitos por COVID-19 e transmissão intra-hospitalar, um risco negligenciado no início da pandemia

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ABSTRACT

Coronavirus disease - 2019 (COVID-19) pandemic challenged Brazil's and the world's health systems. Belo Horizonte (BH), Minas Gerais capital, had the lowest hospital mortality among the capitals of Brazil. To draw conclusions about COVID-19 lethality locally, it is relevant to study the first deaths in the city. This is a descriptive study of the first 100 deaths from COVID-19 that occurred in BH. The medical records were analyzed in partnership with the Strategic Health Surveillance Information Center (CIEVS). The first hundred deaths occurred in 19 hospitals, from March 30 to June 19, 2020; the average age was 69.3 years (±14.8) and the distribution per race was: non-white (n=57), white (n=42) - ignored (n=1). There was an average of 6.5 days between symptoms and hospitalization, 15 days between symptoms and death, and 11 days of hospitalization. There were 25 patients with limited therapeutic effort (LTE). There was an average of 4 comorbidities per patient. Amongst the deaths, there were 14 Healthcare Associated Infections (HAIs) and 24 possible HAIs (pHAIs). The main signs and symptoms were dyspnea (n=100), chest discomfort (n=85), fever (n=77) and cough (n=75). The main comorbidities were age >60 years (n=71), arterial hypertension (n=69) and diabetes mellitus (n=47). The chest radiography images in 75 patients showed interstitial infiltration in 92% and consolidation in 23%, while the chest computerized tomography (CT) scans of 49 patients showed ground-glass infiltration in 86% and consolidation in 35%. The main complications were: septic shock (n=98), secondary sepsis (n=68), hyperglycemia (n=54) and dialytic renal failure (n=49). We call attention to the high frequency of HAIs found in the first 100 deaths in BH, and to the urge to raise suspicion at the beginning of outbreaks and epidemics to diagnose and to install prevention and control measures early.

Keywords: COVID-19; Hospital mortality; Symptoms; Complications; Epidemiology; Risk factors.

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RESUMO

A pandemia de "*coronavirus disease - 2019*" (COVID-19) desafiou o sistema de saúde do Brasil e do mundo. Belo Horizonte (BH), a capital de Minas Gerais, apresentou as menores taxas de mortalidade hospitalar entre as capitais brasileiras. Para tirar conclusões sobre a letalidade do COVID-19 localmente, é relevante estudar os primeiros óbitos ocorridos no município. Este é um estudo descritivo dos primeiros cem óbitos por COVID-19 ocorridos em BH. Os prontuários foram analisados para investigação de óbitos em parceria com o Centro de Informações Estratégicas em Vigilância em Saúde (CIEVS). Os primeiros cem óbitos ocorreram em 19 hospitais, de 30 de março a 19 de junho de 2020; a média de idade foi 69,3 anos (±14,8) e a distribuição por raça foi: parda (50), preta (7), branca (42) - ignorada (1) . Houve uma média de 6,5 dias entre o início dos sintomas e a internação, 15 dias entre o início dos sintomas e o óbito, e 11 dias de internação. Foram 25 pacientes com limitação de esforço terapêutico (LET). Em média, apresentavam 4 comorbidades. Entre os óbitos, 14 foram infecções por SARS-COV-2 consideradas relacionadas à assistência à saúde (IRAS) e 24 possíveis IRAS (pIRAS). Os principais sinais e sintomas observados foram dispneia (n=100), desconforto torácico (n=85), febre (n=77) e tosse (n=75). As principais comorbidades foram idade superior a 60 anos (n=71), hipertensão arterial sistêmica (n=69) e diabetes mellitus (n=47). Dentre as 75 radiografias de tórax, 92% evidenciou presença de infiltrado intersticial e 23%, de consolidação; já nas tomografias computadorizadas (TCs) de tórax de 49 pacientes, em 86%, havia opacidade de padrão "vidro fosco" e, em 35%, consolidação. As principais complicações foram: choque séptico (n=98), sepse secundária (n=68), hiperglicemia (n=54) e insuficiência renal dialítica (n=49). Chamamos atenção para a alta frequência de IRAS encontrada nos primeiros cem óbitos em BH, e para a necessidade de suspeição no início de surtos e epidemias para que seja realizado diagnóstico precoce e instituição rápida de medidas preventivas.

Palavras-chave: COVID-19; Mortalidade hospitalar; Sintomas; Complicações; Epidemiologia; Fatores de risco.

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Introduction

The COVID-19 pandemic challenged the health system in Brazil and around the world, highlighting regional disparities in the access and functioning of health services. One study published by the Imperial College showed geographic and temporal variation in hospital mortality rates from COVID-19 in 14 major Brazilian cities, out of which Belo Horizonte, Minas Gerais' capital, had the lowest rate. In the study, it was projected that, by July 26, 2021, approximately half of hospital deaths from COVID in Brazil could have been avoided if hospital fatality rates were similar to those observed in Belo Horizonte[1]. This variation mirrored healthcare capacity (beds, equipment and healthcare workers), which was due to a combination of pre-pandemic disparities[1].

Belo Horizonte, located in southeastern Brazil, with an estimated population of 2,530,701 inhabitants in 2021, ranks fifth among the most populous in Brazil, with a territory of 331,354 km^2.

According to the Epidemiological and Assistance Bulletin of the City of Belo Horizonte[2] in the fight against COVID-19, the first case reported in Belo Horizonte was on February 28, 2020, and on June 19, 2020 (date on which, according to the present study, the first 100 deaths in BH were completed), there were 3,879 confirmed cases of COVID-19, of which 3,324 patients recovered. Females predominated in confirmed cases during this period in all epidemiological weeks [3].

The Belo Horizonte City Government (PBH) adopted stricter public measures to control the COVID-19 pandemic when compared to other major Brazilian cities [3]. Furthermore, PBH already had a better structured municipal

SUS (Brazil's Public/Universal Healthcare System) network of primary and hospital care compared to the national average[4]. Perhaps these two factors explain the low fatality rate of COVID-19 in BH.

In order to draw conclusions about COVID-19 lethality locally, it is relevant to study the first deaths from the disease that occurred in the city and compare them with other locations' deaths. This investigation seeks to contribute to the knowledge about the natural course of the disease, the demographic profile, the main signs and symptoms, the main complications and the most frequent radiological patterns.

Methods

This is a descriptive study of the first 100 deaths from COVID-19 that occurred in Belo Horizonte (BH). Medical records were analyzed and data collected using a data collection form for death investigation, made available by the Center for Strategic Information on Health Surveillance (CIEVS) in BH, from August to October 2020, in each hospital where the deaths occurred.

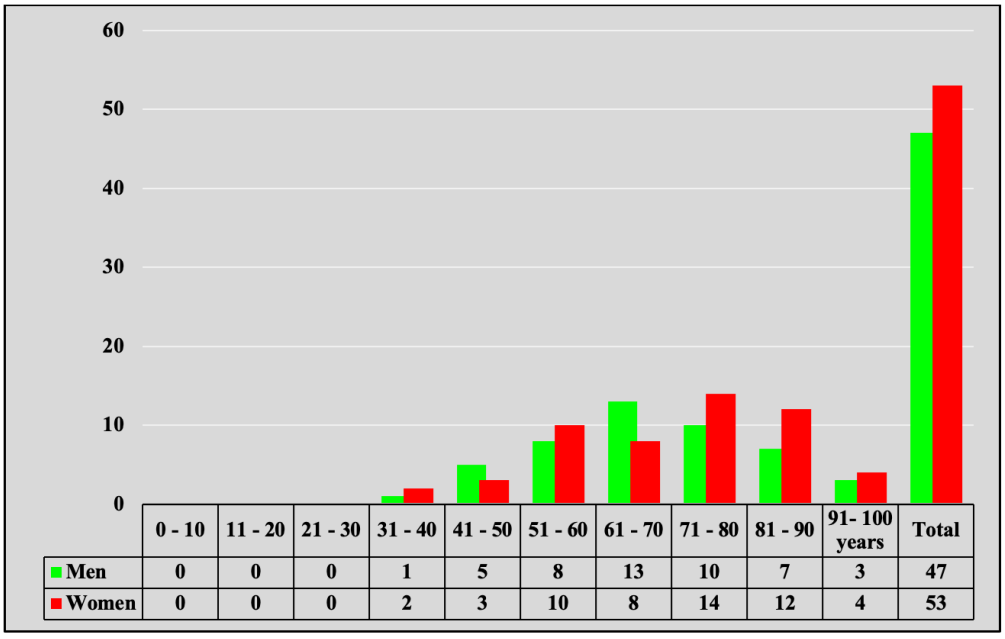
The criteria for including patients in the study were: Patients with deaths due to Severe Acute Respiratory Syndrome (SARS) reported to CIEVS, and diagnosis confirmed by nasopharyngeal swab with RT-PCR for SARS COV-2; these deaths occurred in Belo Horizonte. The exclusion criteria were: deaths from COVID-19 occurring in Emergency Care Units (UPA`s).

The study was approved by the Ethics Committee of the Federal University of Minas Gerais (UFMG) under number CAAE 34103320.6.0000.5149, and the researchers followed international recommendations and Resolution 466/12 of the Conselho Nacional de Saúde (National Health Council)[5]. As a database and statistical analysis tools, Excel 2010 (Microsoft, USA) and SPSS Statistics for Windows and Macintosh, version 19.0 (IBM Corporation, Armonk, NY) were used. Category variables were described as absolute and relative frequency and continuous variables were described by central tendency and variability analysis. Student's T test and the Chi-Square test were used to compare continuous and category variables between the groups of deaths from COVID-19 classified as Healthcare-Related Infection (HAI) and non-HAI. HAI was defined by ANVISA criteria. The level of statistical significance adopted was 0.05.

Patients who did not have the correct date of onset of symptoms and patients with uninformed risk conditions were removed from the calculation. In the analysis of days of symptoms until hospitalization, patients with suspected HAI due to COVID-19 were removed, since the onset of symptoms was during hospitalization (these patients were already hospitalized when developed symptoms). The number of days of hospitalization was corrected to the number of days of hospitalization after the onset of COVID-19 symptoms for patients who were already hospitalized (possible HAIs).

Results

The first hundred deaths from COVID-19 occurred in hospitals in Belo Horizonte from March 30 to June 19, 2020, with an average age of 69.3 years (±14.8) and the gender ratio was slightly higher for women (53%). However, we observed more deaths in men in the younger groups, from 41 to 50 years old, and 61 to 70 years old, but, in those over 70 years old, we found more women than men (Graph 1). The average age for women was 70.2 years and for men 68.4 years.



	0 - 10	11 - 20	21 - 30	31 - 40	41 - 50	51 - 60	61 - 70	71 - 80	81 - 90	91- 100 years	Total
Men	0	0	0	1	5	8	13	10	7	3	47
Women	0	0	0	2	3	10	8	14	12	4	53

Graph 1. Distribution of the frequency of the first 100 deaths from COVID-19 by age group and gender.

Regarding the color/race of the first 100 deaths from COVID-19 in BH, 57 were non-white. 42 of those deaths were from white people and 1 of them did not have its race declared.

The deaths occurred in nineteen hospitals, seven of which were public and twelve were private. There were 64 deaths in public hospitals and 36 deaths in private hospitals. An average of 6.5 days was found from the onset of symptoms to hospitalization, 15.5 days of symptoms to death and 11.3 total days of hospitalization. These patients had an average of 4.1 comorbidities (Table 1). Similar data are reported in other observational studies [6,7].

The days of symptoms until hospitalization or death, and the total number of days of hospitalization, when the result is zero (minimum) (Table 1), indicate that this patient was already hospitalized when they occurred, and these are the cases of possible infections related to assistance (IRAS) or intra-hospital transmission.

Dyspnea, chest discomfort, fever and cough were found in more than 70% of these deaths due to COVID-19, among the first hundred deaths due to COVID-19 in BH (Table 2).

In our analysis, the most frequent risk conditions were: over 60 years of age in 71 deaths, systemic arterial hypertension (SAH) in 69 and diabetes mellitus (DM) in 47 (Table 3).

Up to one fourth of the first 100 deaths investigated by COVID-19 in BH had limited therapeutic effort (LTE) due to advanced diseases, and, on average, up to 4 comorbidities were found in the overall analysis. However, more than 80% of these patients were connected to at least four invasive devices (mechanical ventilation 87%, central venous catheter 84%, indwelling urinary catheter 83%, and nasoenteric tube 83%) (table 4).

In our study, out of 75 chest radiographic images, 92% presented with interstitial infiltration and 23% with consolidation. Out of 49 chest CT images, 86% presented with ground glass opacities.

Our study found that the main complications observed in the evolution of COVID-19 were: septic shock (98%), secondary sepsis (68%), hyperglycemia (54%) and dialytic renal failure (49%) (table 5).

Table 2. Clinical manifestations of the first 100 deaths due to COVID-19 in BH.

Signs/Symptoms	n=100
Dyspnea and Sat <94%	100
Chest discomfort	85
Fever	77
Cough	75
Weakness / adynamia	44
Prostration	41
Loss of appetite	29
Hypotension	27
Confusion	23
Cyanosis	21
Odynophagia	20
Nausea/vomiting	18
Myalgia/arthralgia	16
Diarrhea	15
Expectoration	14
Nasal congestion	10
Chest pain	9
Abdominal pain	8
Headache	8

Of the 100 first deaths from COVID-19 in BH, a total of 14 HAIs were observed, following the ANVISA criteria (which considers HAIs by COVID-19 to be those manifested after at least seven days of hospitalization with an epidemiological link, or ≥14 days without an epidemiological link). However, in this study, we found patients with onset of symptoms between three and six days after admission or after discharge and, if we consider hospital infection that

Table 1. Characteristics of patient deaths from COVID-19 in BH.

	Minimum	Q1	Median	Average	Standard deviation	Q3	Maximum	Missing data
Age	31	59	59	69.3	14.8	81.3	96	0
Number of risk conditions	0	3	4	4.1	2.1	5.5	9	1
Days of symptoms until hospitalization	0	4	6	6.5	3.8	8	17	25
Days of symptoms until death	0	10	14	15.5	9.5	20	61	5
Hospitalization days	0	5	16.5	11.3	16.3	15.3	54	0

Table 3. Main comorbidities of the first 100 deaths due to COVID-19 in BH.

Comorbidities	n=100
Age > 60 years	71
Systemic Arterial Hypertension	69
Diabetes mellitus	47
Chronic obstructive lung disease	32
Obesity	24
Heart failure	22
Hypothyroidism	20
Chronic kidney disease	19
Chronic neurological disease	19
Dyslipidemia	16
Arrhythmia	14
Neoplasm	12
Immunosuppression	11

Table 4. Main invasive procedures performed in the first 100 deaths due to COVID-19 in BH.

Invasive Procedures	n=100
Mechanical ventilation	87
Central venous catheter	84
Indwelling bladder catheter	83
Nasoenteric tube	83
Double lumen catheter	41
Tracheostomy	10
Chest tube	2
Cystostomy	2

did not manifest on admission and occurred 1 to 14 days after admission (SARS-CoV-2 incubation period), we found 24 possible HAIs. This means that up to 24% of these first one hundred deaths could be due to possible intra-hospital transmission.

Continuous and categorical variables between groups of COVID-19 deaths classified as HAIs and non-HAIs were compared to verify possible association. The results found did not show a statistically significant difference in age, gender, race, or indication of limitation of therapeutic effort, between HAI and non-HAI cases (whether following the ANVISA criteria, or possibly HAI). The only statistical association found for deaths from COVID-19 classified as HAI was that related to hospital "X" (Table 6).

Table 5. Mains complications of the first 100 deaths due to COVID-19 in BH.

Complications	n=100
Septic shock	98
Secondary sepsis	68
Hyperglycemia	54
Dialytic kidney failure	49
Non-dialytic kidney failure	29
Cardiorespiratory arrest with resuscitation	20
Atrial fibrillation/Arrhythmia	19
Clotting disorder	15
Decubitus ulcer	10
Neurological alteration	9
Hydroelectrolytic disorder	8
Cardiomyopathy (acute heart attack, failure, myocarditis)	7
Bradycardia	6
Hypertensive Crisis	4
Dysglycemia	2
Ventricular Tachycardia/Fibrillation	2
Thrombosis	1
Rhabdomyolysis	1

Discussion

Our study revealed that in the early stages of the COVID-19 pandemic in Belo Horizonte, MG, the first one hundred deaths occurred between March 30, 2020, and June 19, 2020, across 19 different healthcare institutions, with the majority in private hospitals (7 public vs. 12 private). However, the total number of deaths was higher in public hospitals (64 vs. 36). This could be explained by a higher number of smaller private hospitals, greater demand for the few large public hospitals, or greater vulnerability among the population dependent on public hospitals.

There was a higher prevalence among age groups over 50 years old (89%), with the majority being over 60 years old (71%). Interestingly, there were no deaths below the age of 31. Other national and international studies have also observed high hospital mortality rates from COVID-19 in older adults, as well as a high risk of rehospitalization and death after hospital discharge among them[8].

Additionally, in our sample of 100 COVID-19 deaths, there was a slightly higher proportion of women (53 women vs. 47 men). Some initial Chinese reports found a higher predominance of deaths in men, attributing it to the prevalence of cardiopulmonary diseases and smoking, which make them more susceptible to developing systemic inflammation, multi-organ dysfunction, and cardiac injury[9].

Table 6. Comparative analysis of variables in cases of HAIs and non-HAIs.

Sex							
HAIs	Fem	Males	Total	HAIs	Fem	Male	Total
No.	42	36	78	No.	45	31	86
Yes	11	11	22	Yes	8	6	14
Total	53	47	100	Total	53	47	100
p-value: 0.812 (Chi-square test)				*p*-value: 0.781 (Chi-square test)			

Color										
HAIs	White	Unkwn	Blk	Brown	Total	HAIs	White	Unkwn	Blk	Brown	Total
No	32	1	6	39	78	No	35	1	6	44	86
Yes	10	0	1	11	22	Yes	7	0	1	6	14
Tot	42	1	7	50	100	Tot	42	1	7	50	100
p-value: 0.895 (Chi-square test)						*p*-value: 0.902 (Chi-square test)					

LET						
HAIs	LET no	LET yes	Total	HAIs	LET no	LET yes	Total
No.	59	19	78	No.	64	22	86
Yes	16	6	22	Yes	11	3	14
Tot	75	25	100	Tot	75	25	100
p-value: 0.785				*p*-value: 1.0			

Age					
HAIs	Avg age	Std Dev	HAIs	Avg age	Std Dev
No	70	15	No	70	15
Yes	68	12	Yes	64	12
p-value: 0.35 (T test)			*p*-value: 0.594 (T test)		

However, a growing number of later studies showed little or no gender differences. This could be explained by the higher age attained by women compared to men, resulting in a higher number of exposed women[10].

Our data revealed slight inequality in terms of race/ethnicity among the first one hundred COVID-19 deaths in BH. However, according to the population of Belo Horizonte, based on the latest IBGE data from 2010, "brancos" (white) accounted for 47%, "pardos" (mixed race) 42%, "pretos" (black) 10%, "amarelo" (yellow) 1%, and "indígenas" (indigenous) 0.15%. Black people (considered by IBGE as "pardos"/mixed race and "pretos"/black) make up 52% (the majority of the population of BH), so we cannot assert such inequality in deaths since our findings were similar to the predominance of this group in the population.

Evidence from a moderate to high strength systematic review of 52 studies concluded that African American/black and Hispanic populations had a disproportionate incidence of SARS-CoV-2 infections and COVID-19-related mortality, but did not have higher fatality rates (defined as in-hospital mortality)[11,12]. This does not suggest greater susceptibility to COVID-19, but likely effects of healthcare access and exposure-related factors such as population density and other social inequalities.

Lower respiratory tract infection symptoms, such as those of pneumonia, were frequently observed in patients with risk factors or comorbidities and were more severe to fatal in older patients. On the other hand, upper respiratory tract infection symptoms seem to be related to milder clinical courses. Headache, anosmia, ageusia (or dysgeusia), and rhinitis were mainly observed in younger patients with milder clinical presentations in other studies[13].

Regarding comorbidities, in our analysis, 71 patients were over 60 years old, 69 had systemic arterial hypertension, and 47 had diabetes mellitus. These data are pointed out in the literature as the main risk factors for severe COVID-19 [7, 14-16], which is similar to our findings.

Two meta-analyses provided clinical characteristics of patients diagnosed with COVID-19 and factors associated with severity and mortality. In one, the mean age of patients was 58.42 years, with a prevalence of 79.26% for fever symptoms, 60.7% for cough, 33.2% for fatigue, 31.3% for myalgia, and 10.7% for diarrhea. The most common comorbidities were hypertension (28.30%), diabetes (14.29%), cardiovascular diseases (12.30%), and chronic kidney disease (5.19%)[15]. In the other, significant associations were found between older age (≥65), male gender, hypertension, cardiovascular diseases (CVDs), diabetes, chronic obstructive pulmonary disease (COPD),

and cancer[16]. These findings can contribute to identifying patients at risk of more severe conditions at an early stage.

A study conducted at the beginning of the pandemic in New York City, USA, which included 5,700 individuals, had a mean age of 63 years, with 39.7% women. The most common comorbidities were hypertension (56.6%), obesity (41.7%), and diabetes (33.8%). At screening, 30.7% of patients were febrile, 17.3% had a respiratory rate over 24 breaths per minute, and 27.8% received supplemental oxygen[17]. This case series provides initial characteristics and outcomes of hospitalized patients with COVID-19 and also found a higher age group of 60 years and older, hypertension, and diabetes as the most frequent risk conditions. Symptoms during hospitalization for COVID-19 were less frequent than those found in the deaths of our study, likely due to the greater severity of symptoms in the population limited to fatalities.

In up to 25% of the deaths investigated due to COVID-19, patients had a do-not-resuscitate order, and there was an average of 4 comorbidities in the overall analysis. These data depict an affected population that can serve as a predictor of mortality: elderly patients or those with comorbidities.

Over 80% of these patients underwent at least four invasive procedures (mechanical ventilation, central venous catheter, indwelling urinary catheter, and nasoenteric tube). These invasive procedures breach the patient's physical barrier, predisposing them to bacterial or fungal sepsis, particularly in elderly patients. In a series of laboratory-confirmed critically ill COVID-19 patients in Lombardy, Italy, the majority were older; a significant proportion required mechanical ventilation and high PEEP levels, with ICU mortality at 26%[15]

CT scans can play a role in both diagnosis and assessing the extent of the disease, as well as in follow-up. Chest CT has relatively high sensitivity for diagnosing COVID-1918,19. However, around half of the patients may have a normal CT scan during the first 1 to 2 days of symptom onset[20]. Images of SARS-CoV-2 infection typically show bilateral involvement, with multiple ground-glass opacities or consolidations with a subpleural distribution in various bilateral lobes. These lesions may significantly overlap with those of SARS and MERS[21].

According to a review of 45 studies involving 4,410 patients, ground-glass opacities (GGOs), either isolated (50%) or coexisting with consolidations (44%) in a bilateral and subpleural distribution, were the most prevalent chest CT findings[22]. Another systematic review of imaging findings in 919 patients found bilateral multilobar ground glass opacities (GGOs) with a peripheral or posterior distribution, mainly in the lower lobes as the most common characteristic[23]. Pleural effusion, pericardial effusion, lymphadenopathy, cavitation, halo sign on CT, and pneumothorax were uncommon.

A longitudinal study analyzing 366 serial CT scans in 90 COVID-19 pneumonia patients found that the extent of pulmonary abnormalities progressed rapidly and peaked during days 6 to 11 of the illness[24]. The predominant abnormality pattern after symptom onset was GGOs (45-62%). As pneumonia progresses, the lesion areas increase and develop into diffuse consolidations in both lungs within a few days[25]. Most discharged patients still had residual disease on their final CT scans[24]. Further studies with extended follow-up are needed to assess long-term or permanent lung damage, including fibrosis, as seen with SARS and MERS[26].

The main complications observed in the course of COVID-19 included septic shock, secondary sepsis, hyperglycemia, and dialytic renal failure[27]. These findings, also observed in other studies, assist clinicians in predicting poor outcomes for these patients.

The pathophysiology of COVID-19 shows that SARS CoV-2 enters host cells through the interaction of its spike protein with the ACE2 receptor, ultimately leading to damage to endothelial cells and thromboinflammation, immune response dysregulation, and release of pro-inflammatory cytokines. In addition to hypoxemic respiratory failure, literature data show that COVID-19 complications include approximately 9% renal injury, 19% liver dysfunction, 10 25% bleeding and blood dyscrasia, and 6% septic shock[27].

A retrospective observational study at the University Medical Center Freiburg (Germany) between February 25 and May 8, 2020, included 213 PCR-confirmed SARS CoV-2 patients. The primary outcome was hospital mortality, with secondary outcomes including major complications and causes of death. The median age was 65 years, similar to our study, with the majority being male (61%). Seventy patients (33%) were admitted to the ICU, of whom 57 (81%) received mechanical ventilation. In this study, age ≥65 years and male sex were predictors of hospital death. Predominant complications included multiorgan failure, septic shock, thromboembolic, and hemorrhagic complications, similar to our study. Fifty cases (23%) were considered hospital-acquired infections, similar to our findings. While 56 patients (26%) had no significant comorbidities, 79 patients (37%) reported one, and 78 patients (37%) had two or more comorbidities, with coronary artery disease or ischemic cardiomyopathy (21%), diabetes mellitus (20%), and obesity (BMI > 30mg/ m2, 24%) being the most prevalent diseases. The average time from symptom onset to hospitalization was 6 days[13]. These findings were similar to our study, emphasizing the need for clinicians to pay attention to comorbidities and the natural course of COVID-19 in the differential diagnosis of other viral infections.

When we conducted a comparative analysis of variables (age, gender, race, therapeutic effort limitation, hospital region) in HAIs vs. non-HAIs cases (both according to ANVISA criteria and possible HAIs), the only statistically significant association was related to hospital "X," which is consistent with the COVID-19 hospital outbreak that occurred there. In this specific institution, of the eighteen COVID-19 deaths in the study, fifteen were possible HAIs (83%) and ten were HAIs according to ANVISA criteria (55%).

According to medical record data, the cause of this COVID-19 outbreak at that hospital was delayed suspicion of COVID-19 diagnosis in elderly patients with cardiac and neoplastic comorbidities, initially asymptomatic or with nonspecific symp toms and decompensation of the underlying disease, or with possible overlaid bacterial infection.

In the retrospective study at the University of Freiburg, from February 2020 to May 2020, of the 213 hospitalized SARS-CoV-2 patients, 50 patients (23.47%) were considered HAIs due to COVID-19[13]. This data, as found in our study, highlights the importance of intra-hospital transmission, reinforcing the need for rapid diagnosis and implementation of droplet and aerosol precautions to prevent outbreaks and increased hospital mortality.

The limitation of this study includes the limitations of a retrospective and essentially descriptive study, with data collected from medical records and possible information loss. However, this is characteristic of epidemiological investigation of deaths, which has unquestionable importance, especially in the context of outbreaks and epidemics.

Conclusion

We draw attention to the high frequency of healthcare associated infections (HAI) found in the first one hundred COVID-19 deaths in BH. We emphasize the need for heightened suspicion at the onset of outbreaks and epidemics, to facilitate early diagnosis and rapid implementation of preventive measures against the nosocomial transmission of COVID-19 and potential future epidemic communicable diseases.

Our study was similar to other from different locations in regards to the profile of the first 100 patients that fell victim to COVID-19, mainly with respect to comorbidities. This further proves its importance as predictors of severity, which was perceived already at the beginning of the pandemic and oriented further public health measures. In this sense, studies such as this one can be useful as a model for analysis of future outbreaks and epidemics.

This study contributed to the investigation of the first one hundred COVID-19 deaths in BH, documenting the main demographic, clinical, and radiological findings at the onset of the introduction of this new pandemic virus. The detection of hospital-acquired infection as a high-risk factor for transmission, due to asymptomatic or oligosymptomatic cases, and delayed diagnosis in some instances, serves as a warning for infection control in hospitals, epidemiological surveillance of these healthcare-associated infections, adoption of prevention measures, and timely isolation.

Authors' contributions

Author contributions are structured according to the taxonomy (CRediT) described below:

Concept, Investigation, Method, Visualization & Writing: Karina Martins Nogueira Napoles. Formal analysis, Project management, Supervision, Writing-Revision, Visualization & Editing: Júlia Fonseca de Morais Caporali. Writing-Revision, Visualization & Editing: Pedro Henrique Couto Reis. Project management, Supervision, Writing-Revision & Editing: Unai Tupinambás.

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