








## Lung cancer surgery in Brazil during the COVID-19 pandemic: How many were left behind?

Guilherme Moreira Hetzel<sup>1</sup>, Wallace Klein Schwengber<sup>1</sup>,  
Diego Corsetti Mondadori<sup>2</sup>, Luiz Felipe Lopes Araujo<sup>2</sup>,  
Mauricio Guidi Saueressig<sup>1,2</sup>

### TO THE EDITOR,

Lung cancer is the leading cause of oncological mortality in Brazil, being responsible for approximately 30,000 deaths in 2019.<sup>(1)</sup> To date, surgical treatment is the best therapeutic option for patients with non-small cell lung cancer and is the mainstay approach for early-stage disease (stages I and II). Delays in treatment are thought to be major contributors to suboptimal outcomes, and efforts have been made to reduce the time between the diagnosis and initiation of treatment, with Brazilian laws requiring that such interval must not exceed 60 days, following international guidelines and recommendations.<sup>(2,3)</sup>

The COVID-19 pandemic and its hazardous consequences have brought major difficulties to the diagnosis and management of lung cancer in Brazil.<sup>(4)</sup> Outpatient consultations, as well as surgical and diagnostic procedures, were halted across the country, leading to significant challenges to both diagnosing and treating malignancies following the regular pre-pandemic oncological guideline protocols. Patt et al. (2020) demonstrated that lung cancer screening rates have declined by up to 75% in the U.S. motivated by the pandemic. The decision to reschedule or completely forego screenings by both patients and healthcare providers has led to fewer cancer diagnoses,<sup>(5)</sup> with similar findings being reported in Europe.<sup>(6)</sup> Moreover, a recent systematic review and meta-analysis suggested that extended delay to surgery is associated with decreased overall survival in lung cancer.<sup>(7)</sup> In this context, the impact of the COVID-19 pandemic on the surgical treatment of lung cancer patients in Brazil remains unknown.

Here, we aimed to analyze the impact of the COVID-19 pandemic on the surgical treatment of lung cancer patients in Brazil through a retrospective analysis with a time-series of lung cancer surgeries, from May 2018 to May 2021, collected from the oncology panel<sup>(8)</sup> of the Department of Informatics of the Brazilian National Health System (DATASUS). Of note, the information provided by the oncology panel is registered on the first day of treatment. Data were retrieved following the 10th revision of the International Classification of Diseases (ICD-10), codes C33 and C34, for lung and tracheal cancer surgeries, as well as for chemotherapy and radiotherapy. We defined the beginning of the COVID-19 pandemic in Brazil as April 2020. Data on COVID-19 cases in the country were obtained from the

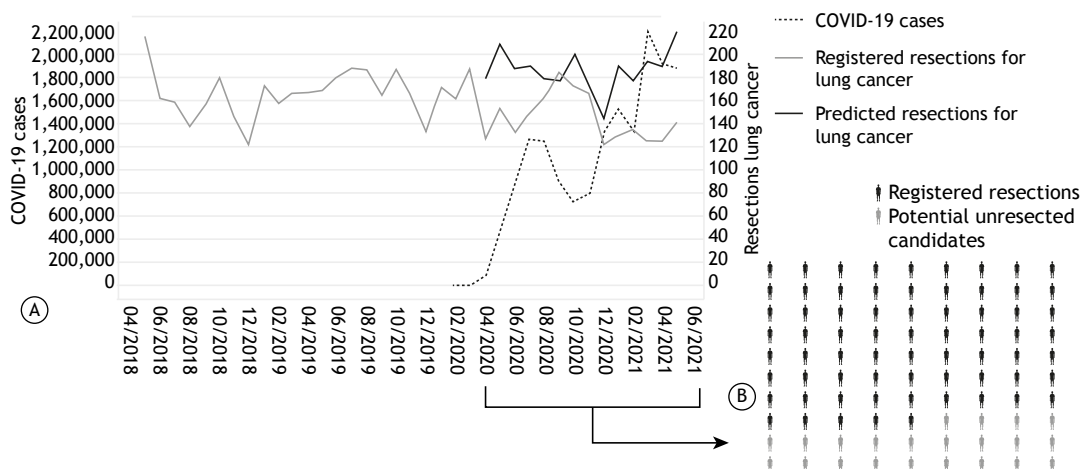
Brazilian Department of Health website.<sup>(9)</sup> All statistical analyses were carried out using the Statistical Package for the Social Sciences (SPSS) software, version 18 (IBM Corp., Armonk, NY, USA). Time-series forecasting was performed using the SPSS time-series modeler/expert modeler.<sup>(10)</sup>

A total of 38,945 patients with lung cancer were treated (including all treatment modalities) in the Brazilian public healthcare system (SUS) from May 2018 to May 2021. When comparing the periods before and after April 2020, we found a median of 1,079 vs. 986 lung cancer patients treated per month, respectively. The median frequency of surgeries for lung cancer registered in Brazil before April 2020 was 164 per month (P25-P75, 155-178). Based on the previous 23 months, a trend for the April 2020 - May 2021 interval was calculated ( $r^2=0.89$ ). In comparison with the predicted trend, there was an actual decrease (mean difference -41.24, 95% CI [-26.63; -55.85]) in the number of lung cancer surgeries registered per month (Figure 1). There was also a negative correlation ( $R=-0.54$ ,  $p=0.03$ ) between the number of lung cancer surgeries and the number of new COVID-19 cases per month since the first confirmed case in February 2020.

Based on the time-series analysis, our study suggests that up to 781 lung cancer patients did not receive appropriate surgical treatment as a consequence of the COVID-19 pandemic in the Brazilian public healthcare system between April 2020 and May 2021 (Figure 1).

Some explanations might account for the different surgery patterns regarding new COVID-19 cases depicted in Figure 1. The first spike in COVID-19 cases initiated in April 2020 and peaked in August of that year. It was significantly associated with fewer surgeries compared to the same interval in 2019 (monthly averages, 142.8 vs. 175.8 surgeries, respectively). Despite relatively few new COVID-19 cases, this stage was marked by lockdown policies and, more importantly, concern among the population, including lung cancer patients who may have preferred to stay home rather than seek appropriate care in hospitals. Meanwhile, the second spike initiated in November 2020 and peaked in April 2021. In this stage, the expected seasonal recovery in lung cancer surgeries following the end and the first few months of the year observed from November 2018 to April 2019 was not reproduced (monthly averages, 152.8 vs. 131.8 surgeries, respectively). We suspect this

1. Hospital de Clínicas de Porto Alegre, Faculdade de Medicina, Universidade Federal do Rio Grande do Sul, Porto Alegre (RS), Brasil.  
2. Serviço de Cirurgia Torácica, Hospital de Clínicas de Porto Alegre, Porto Alegre (RS), Brasil.



**Figure 1.** a) COVID-19 cases in Brazil and the number of registered and predicted resections for lung cancer. COVID-19 cases and resections for lung cancer can be visualized in this figure using different scales. b) Proportion of potential unresected lung cancer surgical candidates: 2,340 resections were registered during the pandemic in the analyzed period, with up to 781 potential candidates for surgical resection being withheld from appropriate treatment.

finding may be part of a reflection of the pandemic's worst scenario in Brazil. In summary, the variation in the number of surgeries showed a modest correlation with the number of new COVID-19 cases; thus, we hypothesize that variables other than raw pandemic patterns may come into play.

The data presented herein has some limitations. First, we recognize that time-series analyses may be prone to errors caused by corrupt or missing data. It is known that DATASUS might have a delay of up to 6 months for procedure registration. The authors regularly checked for updates while writing this manuscript, with stable numbers of procedures in this period. Additionally, unexpected data discrepancies were not observed in the interval used for time-series construction. Second, we evaluated aggregate ecological data, which were not intentionally designed to serve as cancer registries; therefore, the data may be prone to bias. However, DATASUS, the best-known national database available, is based on billing information, being audited by competent authorities. Third, the oncology panel only accounts for patients that effectively started treatment by the Brazilian public health system, so data on the number of lung cancer patients is probably underestimated in our study. Finally, the number of lung cancer patients managed by the private sector

was not included in our analysis. Notwithstanding, SUS is the world's largest public health system with 100% of population coverage, while the private sector provides additional coverage to approximately 25% of the population. From this perspective, we suspect the magnitude of the impact of the COVID-19 pandemic on lung cancer patients might be even greater than that verified herein.

To our knowledge, this is the first study to evaluate the impact of the COVID-19 pandemic on lung cancer surgical treatment using nationwide data. Even though the presented data is descriptive, it may serve as a call for action for health authorities to develop strategies to appropriately manage an upcoming considerable amount of lung cancer patients who were not operated on when necessary as an impact of the ongoing COVID-19 pandemic.

### AUTHOR CONTRIBUTIONS

GMH, WKS, DCM, LFLA, and MGS contributed to the conception and planning of the study, the interpretation of data, writing and reviewing the preliminary and definitive versions, and the approval of the final version of the manuscript.

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