





Impact of the COVID-19 pandemic on coronary artery bypass graft surgery in Brazil: A nationwide perspective

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Abstract

Introduction: The coronavirus disease 2019 (COVID-19) pandemic has been a worldwide challenge, and efforts to “flatten the curve,” including restrictions imposed by policymakers and medical societies, have forced a reduction in the number of procedures performed in the Brazilian Health Care System. The aim of this study is to evaluate the outcomes of coronary artery bypass graft (CABG) from 2008 to 2020 in the SUS and to assess the impacts of the COVID-19 pandemic in the number of procedures and death rate of CABG performed in 2020 through the database DATASUS.

Methods: This study is based on publicly available material obtained from DATASUS, the Brazilian Ministry of Health's data processing system, on numbers of surgical procedures and death rates. Only isolated CABG procedures were included in our study. We used the TabNet software from the DATASUS website to generate reports.

Results: We identified 281,760 CABG procedures performed from January 2008 to December 2020. The average number of procedures until the end of 2019 was of 22,104. During 2020 there was a 25% reduction CABG procedures, to 16,501. There was an increase in the national death rate caused by a statistical significant increase in death rates in Brazil's Southeast and Central-west regions.

Conclusion: The COVID-19 pandemic remains a global challenge for Brazil's health care system. During the year of 2020 there was a reduction in access to CABG related to an increase in the number of COVID-19 cases. There was also an increase in the national CABG death rate.

KEYWORDS

Brazil, coronary artery bypass graft, COVID-19, database, death rate, health care policy, risk adjustment, SARS-CoV-2

1 | INTRODUCTION

The coronavirus disease 2019 (COVID-19) pandemic has affected more than 113 million people and caused more than 2.5 million deaths as of February 2021.¹ Brazil is a country of continental dimensions with significant differences in climate, genetic ancestry and lifestyle across its distinct regions. It occupies 47% of South America's area, mainly in the tropical region, and has more than 200 million inhabitants.² More than 10 million Brazilians have been infected by the virus that causes COVID-19, with more than 250 thousand deaths.³

The pandemic has been a worldwide challenge. Efforts to “flatten the curve” and keep hospital beds and intensive care units available for COVID-19 patients, along with the restrictions imposed by Brazilian policymakers and medical societies, have forced a reduction in the number of procedures performed in the Brazilian Health Care System.⁴

Recently, the outcomes of coronary artery bypass graft (CABG) in the Brazilian public health system (SUS) from January 2008 to December 2017 have been published.⁵

The aim of this study is to evaluate the outcomes of CABG over the next years (2018 to 2020) in the SUS and to assess the impacts of the COVID-19 pandemic in the number of procedures and death rate of CABG performed in 2020 through the database DATASUS.

2 | METHODS

The material was obtained from DATASUS, the data processing system of the Brazilian Ministry of Health, which collects information from every patient who needs in-hospital care and was admitted to a public hospital, gathering and auditing data with relation to number of surgical procedures, death rates and costs.

DATASUS encompasses the Hospital Information System (SIH) as one of its elements. The SIH is based on filling out the Hospital Admission Authorization Form. SUS/SIH resorts to a codification system for every surgical procedure. The current codes for CABG are 0406010927, 04060010935, 0406010943, and 0406010951. All isolated CABG procedures performed in the public health care system were included in our study, regardless of the hospital or city and whether they were on-pump or off-pump. Cases performed in the private sector are not captured in the database and therefore not included in this analysis. In Brazil, all cardiac surgical units contribute to DATASUS, with the exception of the subset of cardiac surgical units that only provide care in the Private Practice model and do not participate in the public health system. CABG with concomitant procedures was excluded. We used the TabNet software⁶ from the DATASUS website to generate reports.

While SUS contains verified patient identifiers to track individuals across hospital admissions within and across the states, DATASUS contains completely deidentified data (i.e., no social security numbers or patient-specific identifiers) using unique patient keys that are tracked by the state. Because DATASUS is a publicly available deidentified database, this study was exempt from patients' consent to have their data included in this report by our Institutional Review Board.

TABLE 1 Data by region in Brazil for CABG (from January 2008 to December 2020)

Region	Number of procedures (%) deaths 2008-2019 (%)	Number of procedures (%) deaths 2020 (%)	OR (95% CI)	p value
Northeast	43,777 (16.5)	2851 (17)	1.00	0.940
	2172 (4.9)	117 (4.1)	(0.83–1.22)	
Southeast	124,271 (46.5)	6713 (41)	1.18	0.001
	6415 (5.2)	406 (6)	(1.07–1.31)	
South	72,105 (27)	5259 (32)	1.08	0.179
	4266 (5.9)	335 (6.3)	(0.96–1.12)	
Central-West	17,372 (7)	1042 (6)	1.62	<0.001
	1403 (8)	130 (12.4)	(1.34–1.97)	
North	7734 (3)	636 (4)	1.09	0.574
	620 (8)	55 (8.6)	(0.81–1.45)	
Total	265,259	16,501	1.13	<0.001
	14,876 (5.6)	1043 (6.3)	(1.06–1.21)	

Note: OR, 95% CIs, and *p* values calculated comparing results in 2020 (year of the pandemic) with results over the period between 2008–2019. Abbreviations: CABG, coronary artery bypass graft; CI, confidence interval; OR, odds ratio.

Number of CABG procedures and death rates were the main outcomes of interest.

The number of COVID-19 notification cases and deaths is published by the Ministry of Health at https://susanalitico.saude.gov.br/extensions/covid-19_html/covid-19_html.html. Data are reported comparing the number of COVID-19 cases and the number of CABG by month.

2.1 | Statistical analysis

The χ^2 test was used to compare death rates. Odds ratio and 95% confidence intervals were calculated. Comparison was calculated between the results in 2020 (year of the pandemic) with results over the period between 2008 and 2019. Statistical analysis was performed using PASW version 18.0 (SPSS). A *p* value of less than 0.05 was considered to indicate a statistically significant result.

3 | RESULTS

3.1 | Mortality rates and surgical volumes

We identified 281,760 CABG procedures performed from January 2008 to December 2020. The overall in-hospital mortality over the period was 5.65%. The average number of procedures until the end of 2019 was of 22,104. During 2020 there was a 25% reduction in

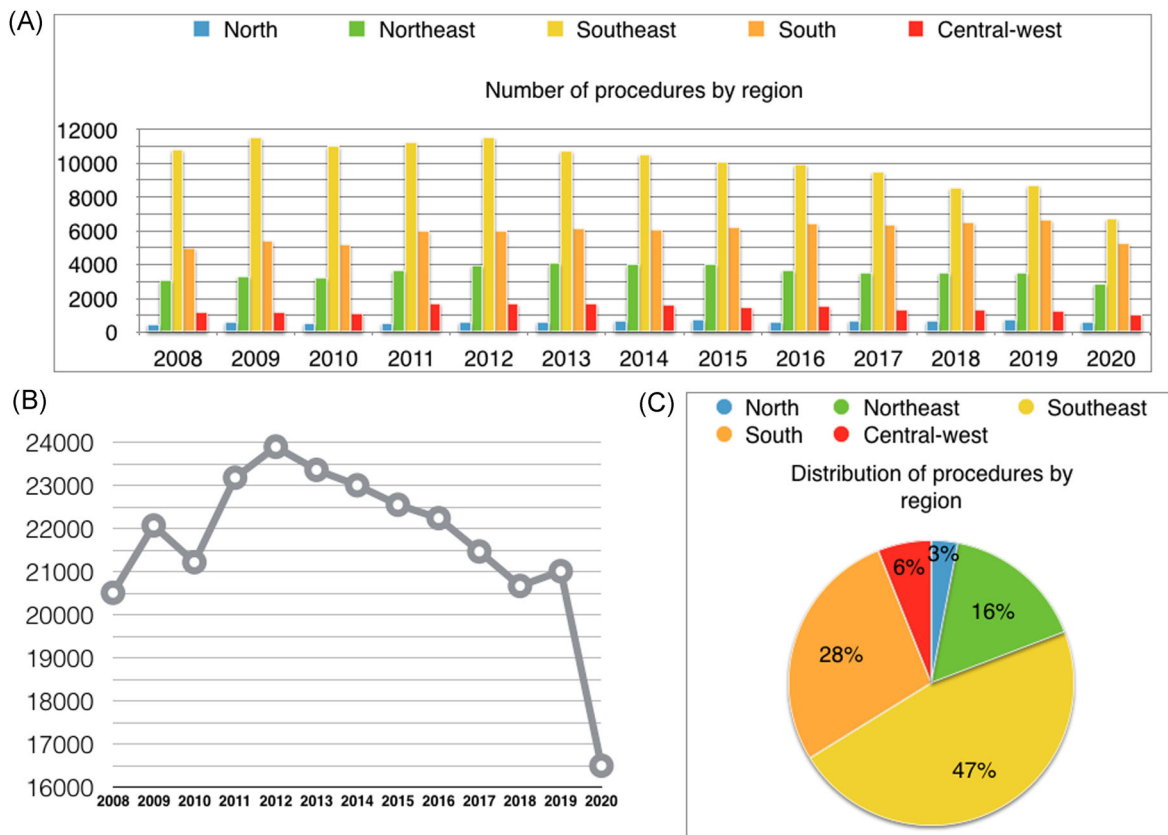


FIGURE 1 Coronary artery bypass graft in Brazil. (A) Number of procedures by region over the years. (B) Number of procedures by year. (C) Distribution of procedures by region

CABG procedures, to 16,501 (see Table 1). There was an increase in the national death rate caused by a statistical significant raise in death rates from the Southeast and Central-West regions. Figure 1A,B display the trends between 2008 and 2020, showing increasing numbers of cases from 2008 to 2012 and decreasing numbers of cases from 2012 to 2018, a slight increase in 2019 and the significant reduction in 2020.

Nearly all of the decrease in case volume over the study time frame occurred in the Southeast Region. The Southeast was responsible for almost 50% of CABG surgeries. Together, the Southeast and South were responsible for almost 75% of all surgeries (see Figure 1C).

The first case of COVID-19 was diagnosed in Brazil in the end of February 2020 and the first death reported in the middle of March 2020. By the end of March over 4500 cases had been diagnosed, and policymakers and medical societies were beginning to raise the red flag. Figure 2A shows the COVID-19 new cases and deaths by day of notification. Clearly, as the cases of COVID-19 began

increasing during March, the number of CABG decreased as surgeons needed to postpone elective procedures (see Figure 2B). By August the number of cases and deaths had begun to decrease and as hospital beds and intensive care units (ICUs) were becoming available the number of procedures increased again. Interestingly, during the South region increased its volume of surgeries in 2020 by 5%, probably affected by the number of procedures performed in the Southeast (see Figure 2C).

4 | DISCUSSION

The COVID-19 pandemic has been one of the great challenges of the medical community and for health care policymakers. In Israel there was a decline in patients undergoing cardiac surgery and an increase in surgical death rate.⁷ The daily routines of society, world economy and practice of cardiac surgeons has changed.⁸ It is well established that the extracorporeal circulation generates a systemic inflammatory response syndrome and that severe acute respiratory syndrome (SARS) from COVID-19 may lead to “cytokine storm” resulting in shock and death, as reported by a cardiovascular division in Italy.^{9,10}

It has been reported that patients who underwent cardiac surgery during 2020 have been infected with COVID-19, and that patients with CVD are more likely to have a severe presentation of SARS from COVID-19.¹¹ Another major concern is that patients with CVD disease are afraid to call emergency assistance or go to emergency rooms for fear of contracting COVID-19 or burdening an already-overwhelmed health-care system.¹² One possible explanation to the increase in death rate is that in most of the time only emergency surgeries were allowed, characterizing more severe patients.

Our institution is a regional hospital in the north of the state of Parana. It provides health care for more 150 cities in Parana, in the

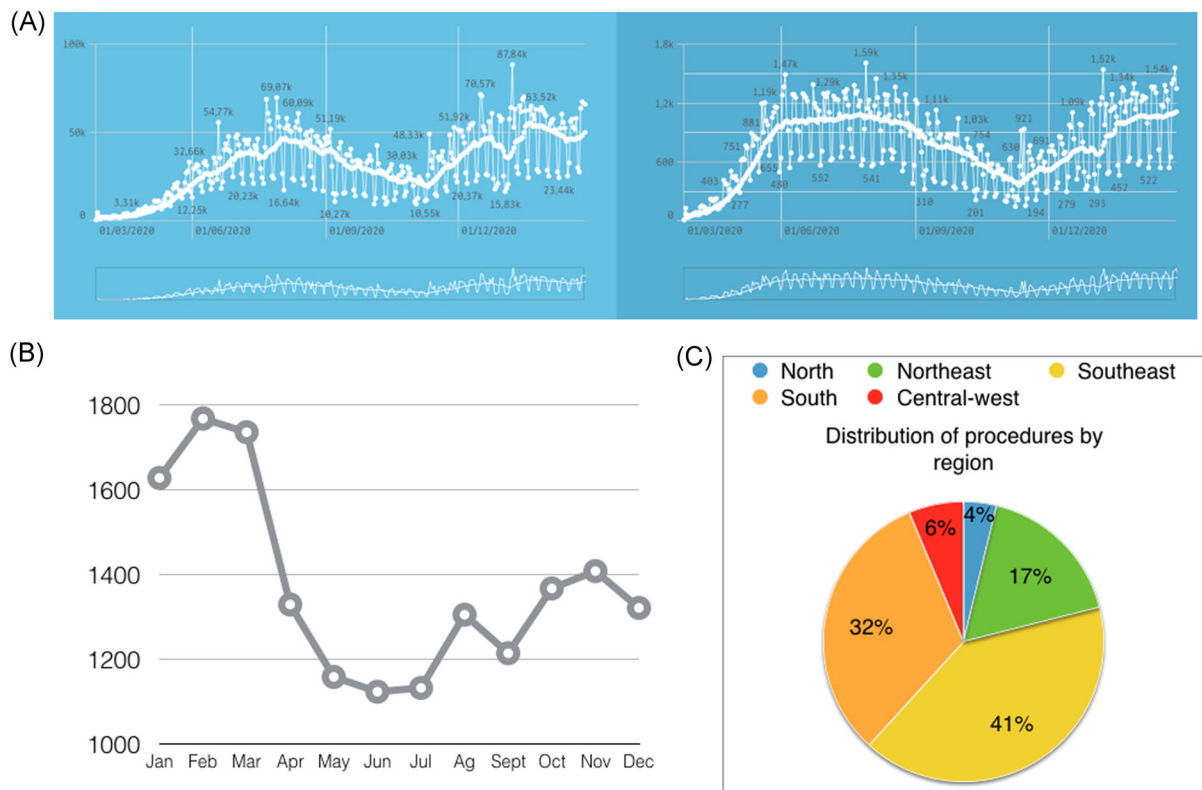


FIGURE 2 (A) COVID-19 new cases and deaths by day of notification (available from https://susanalitico.saude.gov.br/extensions/covid-19_html/covid-19_html.html). (B) Number of CABG by month in 2020. (C) Distribution of CABG by region in 2020. COVID-19, coronavirus disease 2019

specialties of Cardiology, Cardiac Surgery, Oncology, Orthopedic surgery, General surgery and Neurosurgery, Urology, Vascular surgery, and others.

The institution was transformed into a COVID-19 reference center, with more than 60% of hospital beds rearranged to receive COVID-19 patients, and the opening of new ICUs. It was necessary to postpone elective surgeries as suggested by the policymakers of our state. Even though we continue to receive CVD patients in the emergency room, many refuse surgery due to the risk of contracting COVID-19. In general, patients who underwent surgery were in an emergency situation. A comparison of volume of procedures between 2019 and 2020 showed that while some hospitals in the State of Parana managed to increase their volume by 100%, others experienced volume reductions of 66%. The State had an average reduction of 21.5% in CABG. Our institution reduced its procedures by 39%. One possible explanation would be that some hospitals, mainly larger institutions, were transformed into COVID-19 reference centers, and smaller centers were able to continue cardiac surgery expansion.

This seems to be the new reality in the worldwide health care system. As we write this paper, we are living through an even more severe, second wave of the pandemic, which has led the state Governor to impose a lockdown. The year 2021 may see a continued reduction in the number of cardiac procedures nationwide and at our service, with continued postponement of elective surgeries where possible.

4.1 | Limitations of this study

Despite the availability of data on all CABG procedures performed over the years, there is no national database that gathers information on risk-adjusted mortality. Even though DATASUS is open to the public and 100% of public cardiac units contribute data under government surveillance, there is no granularity on the quality and surgical outcomes of CABG, nor why the treatment of choice was CABG. The lack of data granularity of DATASUS is a major concern. There are no data on the outcomes in patients who had postponed surgeries. There also are no data on the clinical outcomes of patients submitted to CABG who became infected with COVID-19 during perioperative care, which could be a contributing factor to the increase in death rate.

5 | CONCLUSION

COVID-19 remains a worldwide challenge for the health care system. During the 2020 there was a reduction in access to CABG related to an increase in the number of COVID-19 cases. There was also an increase in the national CABG death rate compared with the last decade.

CONFLICT OF INTERESTS

The authors declare that there are no conflict of interests.

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