

ORIGINAL ARTICLE

Impact of the COVID-19 Outbreak on Coronary Artery Bypass Grafting in Brazil

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Abstract

Background: The COVID-19 pandemic has disrupted the routine of emergency centers around the world, including in Brazil, where the crisis has affected the volume of major cardiac surgeries such as coronary artery bypass grafting.

Objective: To analyze the impact of the COVID-19 pandemic on the number of surgical procedures for coronary artery bypass grafting in Brazil.

Methods: An ecological, cross-sectional, quantitative, and descriptive study was conducted. Data for the period from July 2018 to June 2019 and from July 2020 to June 2021 were collected from SIHSUS using DATASUS/Tabwin.

Results: A global reduction of 26.58% was observed in the analyzed population, with on-pump coronary artery bypass grafting decreasing by 28.10%, and off-pump coronary artery bypass grafting reduced by only 10.31%.

Conclusion: During the pandemic, there was a 26.58% reduction in the number of surgical procedures for myocardial revascularization in Brazil.

Keywords: COVID-19; Coronary Disease; Myocardial Revascularization; Cardiovascular Surgical Procedures; Public Health

Introduction

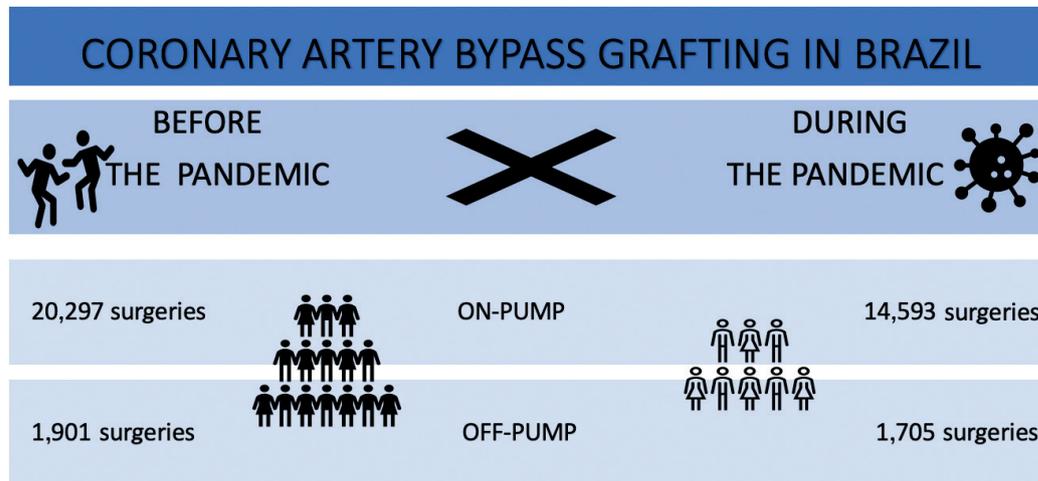
The world witnessed a high mortality rate due to respiratory failure caused by COVID-19, a disease resulting from SARS-CoV-2.¹⁻³ In Brazil, the reality was no different; since the first case reported to the Ministry of Health, on February 26, 2020, the numbers of deaths from severe acute respiratory syndrome were catastrophic.⁴ However, this lethality of the pandemic seemed to extend to patients with other comorbidities and was not limited to those infected with the coronavirus.³ One of the reasons was that the number of patients with acute coronary syndrome who sought medical care significantly decreased, coupled with a reduction in the number of emergency coronary procedures performed during the period of social distancing, as reported by cardiologists. Consequently, there has been a decline in hospitalizations for myocardial infarction in the United States, Europe, and South America.^{2,5-7}

In this scenario, various surgical procedures have been cancelled, resulting in unprecedented implications for surgical survival and for patients in need of surgical intervention.⁸ In particular, cardiac surgery, which is highly dependent on resources, has been significantly impacted, with most elective procedures being postponed or cancelled during the pandemic.⁹ As a result, there has been a substantial decrease in large-scale cardiac procedures.¹⁰

This prompts us to reflect upon the importance of cardiac surgery, a medical discipline that has experienced rapid advancement and refinement since its inception.¹¹ This is substantiated by the emergence of coronary artery bypass grafting (CABG) without the use of cardiopulmonary bypass (off-pump), which followed a few years after the introduction of on-pump CABG.¹² Nonetheless, these procedures are primarily indicated with the aid of scoring systems such as SYNTAX for risk stratification, especially when coronary artery

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Central Illustration: Impact of the COVID-19 Outbreak on Coronary Artery Bypass Grafting in Brazil

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disease affects the left main trunk and triple vessels, which can determine a poor prognosis.¹¹ Consequently, it has become evident that surgeries canceled due to the pandemic brought danger to the lives of these patients, as adequate risk stratification was not followed due to the sanitary imperatives.

Against the backdrop of the current COVID-19 pandemic, which has affected more than 248 million individuals and led to more than 5 million deaths worldwide since its emergence, it is crucial to understand the reality of Brazil, which has a population of over 200 million and has witnessed over 600,000 accumulated deaths.¹³⁻¹⁴ In this context, this study aims to quantify and investigate whether there has been a reduction in on-pump and off-pump CABG procedures in each state of the country.

Methods

This is an ecological, cross-sectional study with a descriptive and quantitative approach. The analyzed data were provided by the Hospital Information System of the Brazilian Unified Health System (SIHSUS), which is made available through the Department of Informatics of the Brazilian Unified Health System (DATASUS/TABWIN). The source selected for data download was SIHSUS, and the file type was Professional Services (SP).¹⁵ All data were analyzed and compared using Excel® 2013

software, allowing for a comparative epidemiological analysis of how the COVID-19 pandemic affected the volume of CABG procedures.

The study period was from July 1, 2018, to June 30, 2019, and from July 1, 2020, to June 30, 2021. The study comprises CABG procedures performed in the 26 states of Brazil and the Federal District. Valve replacement surgeries with CABG and valve repair with CABG were excluded in order to restrict this study to coronary syndromes and limit surgical indications of cases where the predominant cause was not coronary artery disease, but rather valve replacement or repair.

Results

During the study period, the number of CABG surgeries performed in hospitals of the Brazilian Unified Health System totaled 22,198 prior to the onset of the pandemic, and 16,298 procedures were completed during the pandemic, representing a decrease of 26.58% in surgical volume. Graph 1 illustrates a comparison of the total number of CABG surgeries carried out before and during the pandemic in each state of the country, as well as the Federal District during the same timeframe.

According to the national reduction percentage of 26.58%, it is worth noting that some states surpassed this threshold, namely, Tocantins with a 63.40% reduction,

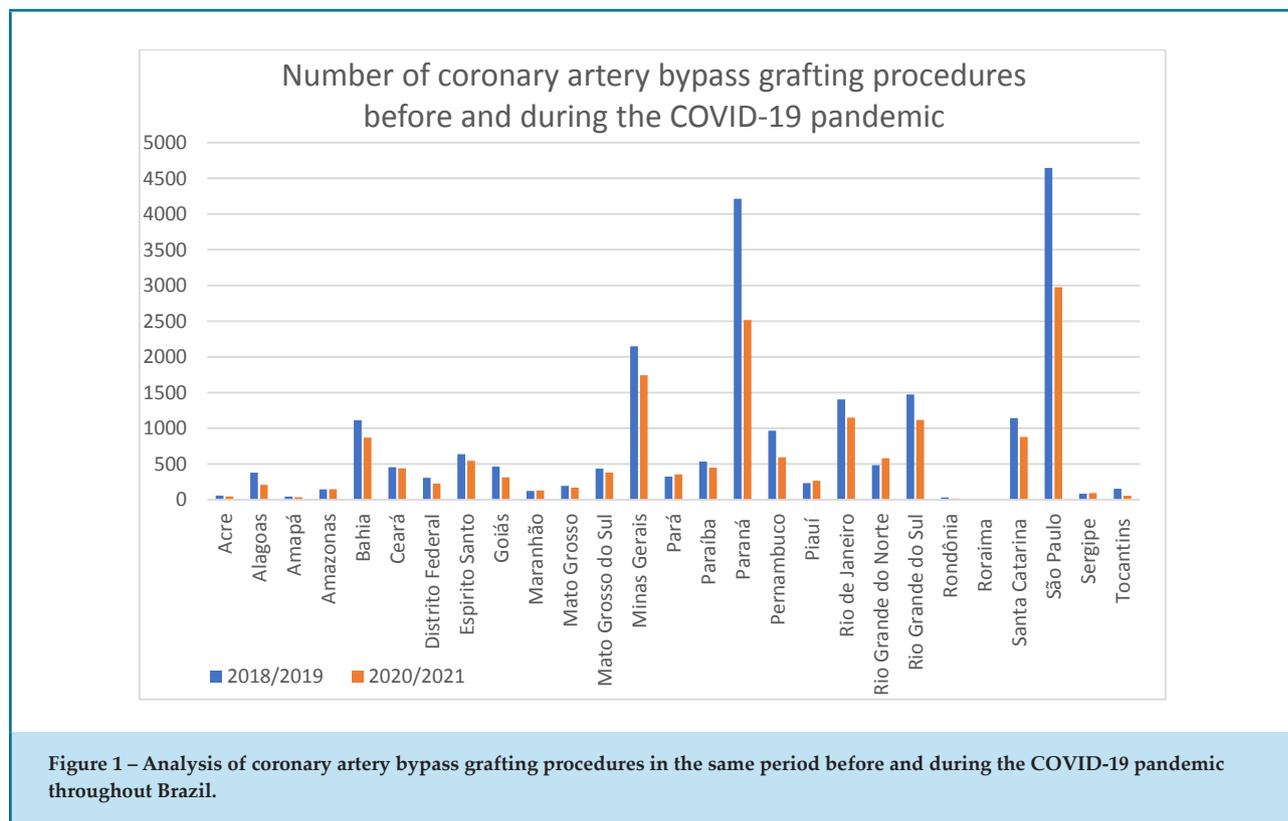


Figure 1 – Analysis of coronary artery bypass grafting procedures in the same period before and during the COVID-19 pandemic throughout Brazil.

Rondônia with 50.00%, Alagoas with 44.85%, Paraná with 40.32%, Pernambuco with 38.61%, São Paulo with 35.97%, Goiás with 32.18%, and the Federal District with a 26.62% reduction.

Given the severity of the pandemic, it was expected that the reduction in the volume of CABG procedures would occur in all states of the nation; however, this was not observed in the following states, with their respective increases: Rio Grande do Norte (20.25%), Piauí (13.73%), Pará (9.60%), Sergipe (9.41%), Maranhão (4.03%), and Amazonas (1.37%). Nonetheless, the epicenter of the pandemic in Brazil was in the Southeast and Central-West regions. The resource consumption in these regions could possibly explain the increase in compensatory elective procedures in the Northeast and North of the country. In addition, the individualized management adopted in response to the health crisis in each state of the country must be taken into consideration.⁴

In Graph 2, on-pump CABG surgeries were isolated and compared between the same periods in each state. According to the study, the Central Figure shows that there were 20,297 surgeries before the pandemic and 14,593 during the pandemic, indicating a reduction of

28.10%. Increases were also observed in the following states: Amazonas (2.10%), Maranhão (4.07%), Pará (9.60%), Piauí (19.63%), and Sergipe (7.14%). In Graph 3, off-pump CABG surgeries were isolated and compared between the states in the studied periods. The Central Figure shows that, before the pandemic, there were 1,901 surgeries, and during the pandemic, only 1,705 were performed, representing a reduction of 10.31%. Nonetheless, there were increases in Alagoas, which went from procedures before the pandemic to 10 during the pandemic in the analyzed period, Ceará with a 29.10% increase, Espírito Santo with 50%, Rio Grande do Norte with 102.04%, Santa Catarina with 12.50%, Sergipe with 200.00%, and Tocantins, which went from 0 to 1 procedure.

When analyzing each type of CABG surgery in isolation, it was expected that on-pump surgeries would have a greater reduction in volume compared to off-pump surgeries. This is because patients who undergo off-pump surgeries demonstrate better preservation of pulmonary function and fewer complications requiring prolonged hospital stay during the postoperative period. However, studies have shown that there is no difference in long-term

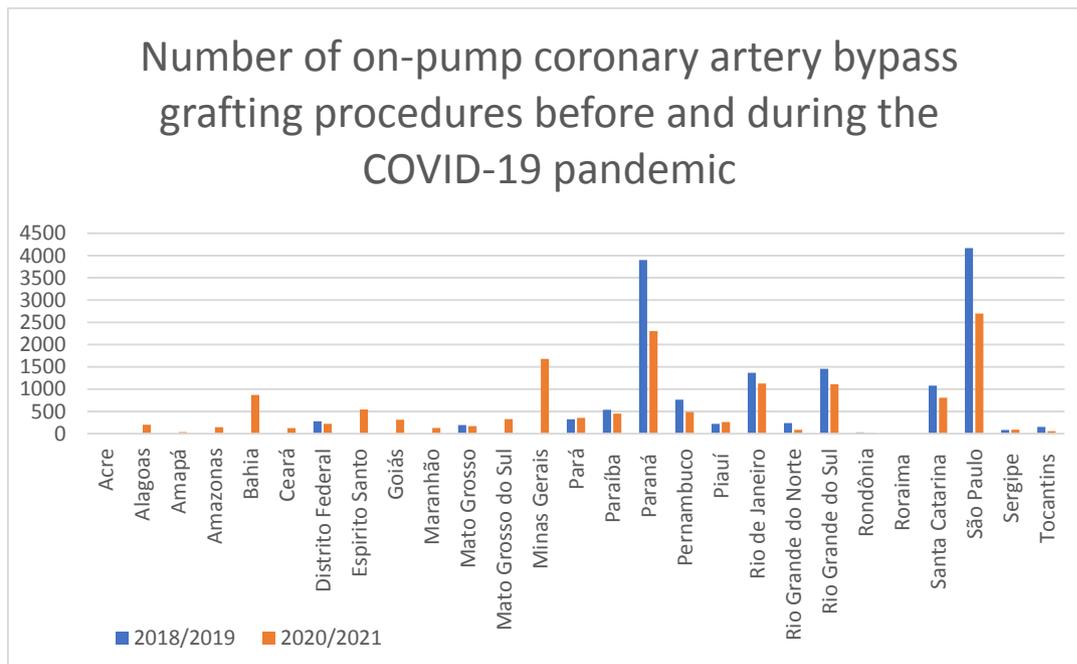


Figure 2 – Analysis of the number of on-pump coronary artery bypass grafting procedures in the same period before and during the COVID-19 pandemic throughout Brazil.

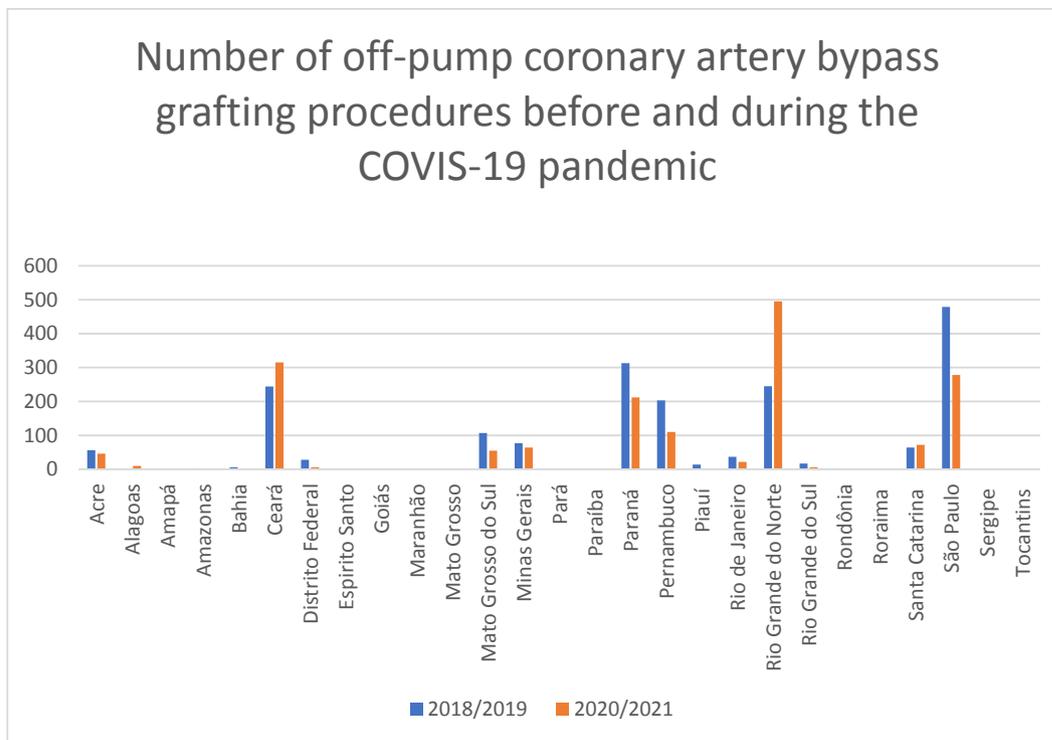


Figure 3 – Analysis of the number of off-pump coronary artery bypass grafting procedures in the same period before and during the COVID-19 pandemic throughout Brazil.

benefits between the two procedures.^{16,17} Furthermore, it has been shown that the use of on-pump surgery induces a systemic inflammatory syndrome, which often leads to transient immunosuppression states, contributing to the faster appearance of COVID-19 symptoms in the postoperative period of infected patients.¹⁸

Discussion

During the pandemic, hospitals had to quickly adapt to increase their capacity for patient care, as a large portion of the population required hospitalization. These measures were adopted to "flatten the curve" and keep hospital beds and intensive care units available for COVID-19 patients. As a consequence, there was a reduction in the number of surgical procedures performed worldwide.¹⁹⁻²²

In Brazil, it was no different; with the sudden increase in the number of COVID-19 cases, exceptional measures were taken, such as the opening of field hospitals and the hiring of clinical and intensive care unit beds, even using the private sector, to increase the capacity for patient care.²³ In the midst of this scenario of scarcity of vacancies, there were even greater complications due to the lack of essential materials for CABG, such as equipment for extracorporeal circulation and cannulas.²⁴

In addition to these scarcity factors that prevented elective cardiac surgeries from being performed, the suspension of surgeries in patients infected with SARS-CoV-2 also became a factor to consider. It was observed that the risk of death or severe postoperative complications in patients who tested positive for COVID-19 with reverse transcription-polymerase chain reaction (RT-PCR) decreased over time. Thus, there is a direct relationship between the interval from the positive test and the date of surgery.¹⁸ However, the individual risk of each patient must be considered to predict the best prognosis, establishing a balance between potential risks and time of positive RT-PCR.²⁴

In this new landscape, it is also necessary to consider that patients undergoing CABG surgery are at risk of exposure to the virus, given that the surgery is highly invasive, generates aerosols, potentially requires prolonged stay in the intensive care units, and involves intense use of healthcare resources. Therefore, several recommendations and guidelines have emerged on how to conserve resources and screen patients who require more urgent and efficient care.²⁵

Because of all the difficulties related to scarcity and decision-making during the COVID-19 pandemic, people may have neglected their symptoms of coronary syndrome due to fear of contracting the virus in a hospital environment, which explains the drop in visits to the cardiac emergency room.^{2,5-7,26} In this scenario of interruption of elective procedures and delay in seeking care, one consequence observed was a change in the clinical profile of patients, justified by the increase in emergency procedures and mortality.²⁷

All actions taken during the pandemic were indeed necessary to minimize the exposure of surgical patients and healthcare professionals to the COVID-19 virus, as well as to ration the use of essential supplies and allocate the necessary personnel to emergency and intensive care centers.²⁵ While the importance of these measures cannot be overstated, the impact of COVID-19 on the daily practice of surgeons and residency programs was profound. The cancellation of elective and non-urgent surgeries allowed surgeons to become a critical team, considering safe alternative non-surgical options to treat their patients.²¹ However, the number of patients waiting for surgery tripled during this dark period, and, although there have already been some consequences, surgery cancellations will continue to affect patients for years to come.^{24,27} It is still unknown what the actual outcome of all this will be, and recovery will depend on multilateral and collaborative results to ensure patient safety and health.^{26,27}

Conclusions

There was an overall reduction in CABG procedures in Brazil, although six states were still able to increase the volume of procedures. This reflects the severity of the pandemic in the country, highlighting how it consumes the hospital resources necessary for CABG procedures. With the increase in wait times for surgeries and the consequent worsening of the presentation profile of these patients, it is questionable whether elective CABG procedures should have been put on the back burner.

Author Contributions

Conception and design of the research, analysis and interpretation of the data and critical revision of the manuscript for intellectual content: Machado FA, Almeida RMS; acquisition of data and writing of the manuscript: Machado FA.

Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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Study Association

This study is not associated with any thesis or dissertation work.

Ethics Approval and Consent to Participate

This article does not contain any studies with human participants or animals performed by any of the authors.

References

- Wu Y, Ho W, Huang Y, Jin DY, Li S, Liu SL, et al. SARS-CoV-2 is an Appropriate Name for the New Coronavirus. *Lancet*. 2020;395(10228):949-50. doi: 10.1016/S0140-6736(20)30557-2.
- Mafham MM, Spata E, Goldacre R, Gair D, Curnow P, Bray M, et al. COVID-19 Pandemic and Admission Rates for and Management of acute Coronary Syndromes in England. *Lancet*. 2020;396(10248):381-9. doi: 10.1016/S0140-6736(20)31356-8.
- Banerjee A, Pasea L, Harris S, Gonzalez-Izquierdo A, Torralbo A, Shallcross L, et al. Estimating Excess 1-Year Mortality Associated with the COVID-19 Pandemic According to Underlying Conditions and Age: A Population-Based Cohort Study. *Lancet*. 2020;395(10238):1715-25. doi: 10.1016/S0140-6736(20)30854-0.
- Brasil. Ministério da Saúde. Secretaria de Vigilância em Saúde. Boletim Epidemiológico Especial 43. Doença pelo Coronavírus COVID-19 [Internet]. Brasília: Ministério da Saúde; 2020 [cited 2022 Mar 3]. Available from: https://www.gov.br/saude/pt-br/centrais-de-conteudo/publicacoes/boletins/boletins-epidemiologicos/covid-19/2020/boletim_epidemiologico_covid_43_final_coe.pdf/view
- Garcia S, Albaghdadi MS, Meraj PM, Schmidt C, Garberich R, Jaffer FA, et al. Reduction in ST-Segment Elevation Cardiac Catheterization Laboratory Activations in the United States During COVID-19 Pandemic. *J Am Coll Cardiol*. 2020;75(22):2871-72. doi: 10.1016/j.jacc.2020.04.011.
- Solomon MD, McNulty EJ, Rana JS, Leong TK, Lee C, Sung SH, et al. The Covid-19 Pandemic and the Incidence of Acute Myocardial Infarction. *N Engl J Med*. 2020;383(7):691-3. doi: 10.1056/NEJMc2015630.
- Cataldo P, Verdugo FJ, Bonta C, Dauvergne C, García A, Méndez M, et al. Consequences of COVID-19 Pandemic on Myocardial Infarction Reperfusion Therapy and Prognosis. *Rev Med Chil*. 2021;149(5):672-81. doi: 10.4067/s0034-98872021000500672.
- Sørøide K, Hallet J, Matthews JB, Schnitzbauer AA, Line PD, Lai PBS, et al. Immediate and Long-Term Impact of the COVID-19 Pandemic on Delivery of Surgical Services. *Br J Surg*. 2020;107(10):1250-61. doi: 10.1002/bjs.11670.
- Shah SMI, Zafar MDB, Yasmin F, Ghazi EM, Jatoi HN, Jawed A, et al. Exploring the Impact of the COVID-19 Pandemic on Cardiac Surgical Services: A Scoping Review. *J Card Surg*. 2021;36(9):3354-63. doi: 10.1111/jocs.15746.
- Casey L, Khan N, Healy DG. The Impact of the COVID-19 Pandemic on Cardiac Surgery and Transplant Services in Ireland's National Centre. *Ir J Med Sci*. 2021;190(1):13-7. doi: 10.1007/s11845-020-02292-6.
- Sens B, Kumar A, Diaz RR. Cardiac Surgery. 2021 Sep 18. In: *StatPearls*. Treasure Island (FL): StatPearls Publishing; 2021.
- Buffolo E, Lima RC, Salerno TA. Myocardial Revascularization without Cardiopulmonary Bypass: Historical Background and Thirty-Year Experience. *Rev Bras Cir Cardiovasc*. 2011;26(3):3-7. doi: 10.5935/1678-9741.20110002.
- Johns Hopkins Coronavirus Resource Center [Internet]. Baltimore: Johns Hopkins University; 2021 [cited 2022 Nov 11]. Available from: <https://coronavirus.jhu.edu/map.html>.
- Brasil. Ministério da Saúde. Análise de Situação de Saúde [Internet]. Brasília: Ministério da Saúde; 2021 [cited 2022 Nov 11]. Available from: https://susanalitico.saude.gov.br/extensions/covid-19_html/covid-19_html.html.
- Brasil. Ministério da Saúde. DATASUS [Internet]. Brasília: Ministério da Saúde; 2021 [cited 2022 Nov 11]. Available from: <http://www2.datasus.gov.br/DATASUS/index.php?area=02>.
- Guizilini S, Gomes WJ, Faresin SM, Bolzan DW, Alves FA, Catani R et al. Evaluation of Pulmonary Function in Patients Following on and Off-Pump Coronary Artery Bypass grafting. *Braz J Cardiovasc Surg*. 2005;20(3):310-6. doi: 10.1590/S0102-76382005000300013.
- Shaefi S, Mittel A, Loberman D, Ramakrishna H. Off-Pump versus On-Pump Coronary Artery Bypass Grafting-A Systematic Review and Analysis of Clinical Outcomes. *J Cardiothorac Vasc Anesth*. 2019;33(1):232-44. doi: 10.1053/j.jvca.2018.04.012.
- Gomes WJ, Rocco J, Pimentel WS, Pinheiro AHB, Souza PMS, Costa LAA, et al. COVID-19 in the Perioperative Period of Cardiovascular Surgery: the Brazilian Experience. *Braz J Cardiovasc Surg*. 2021;36(6):725-35. doi: 10.21470/1678-9741-2021-0960.
- Khalil KH, Sá MPBO, Vervoort D, Roever L, Pires MAA, Lima JMO, et al. Impact of the COVID-19 Pandemic on Coronary Artery Bypass Graft Surgery in Brazil: A Nationwide Perspective. *J Card Surg*. 2021;36(9):3289-93. doi: 10.1111/jocs.15765.
- Griffin KM, Karas MG, Ivascu NS, Lief L. Hospital Preparedness for COVID-19: A Practical Guide from a Critical Care Perspective. *Am J Respir Crit Care Med*. 2020;201(11):1337-44. doi: 10.1164/rccm.202004-1037CP.
- Al-Jabir A, Kerwan A, Nicola M, Alsafi Z, Khan M, Sohrabi C, et al. Impact of the Coronavirus (COVID-19) Pandemic on Surgical Practice - Part 1. *Int J Surg*. 2020;79:168-79. doi: 10.1016/j.ijsu.2020.05.022.
- Dallan LAO, F Lisboa LA, Dallan LRP, Jatene FB. Impact of COVID-19 on Coronary Artery Surgery: Hard Lessons Learned. *J Card Surg*. 2021;36(9):3294-5. doi: 10.1111/jocs.15769.
- Brasil. Ministério da Saúde. Portaria nº 1.514, de 15 de junho de 2020. Define os critérios técnicos para a implantação de Unidade de Saúde Temporária para assistência hospitalar - HOSPITAL DE CAMPANHA - voltadas para os atendimentos aos pacientes no âmbito da emergência pela pandemia da COVID-19. Brasília, Diário Oficial União, 16 jun. 2020.
- Almeida RMS, Marin-Cuarteras M, García-Villarreal OA, Dayan V. COVID-19 and Cardiovascular Surgery. Do We Know What We Are Dealing With? *Braz J Cardiovasc Surg*. 2021;36(6):3-4. doi: 10.21470/1678-9741-2021-0962.
- Patel V, Jimenez E, Cornwell L, Tran T, Paniagua D, Denktas AE, et al. Cardiac Surgery During the Coronavirus Disease 2019 Pandemic: Perioperative Considerations and Triage Recommendations. *J Am Heart Assoc*. 2020;9(13):e017042. doi: 10.1161/JAHA.120.017042.
- Guimarães RB, Falcão B, Costa RA, Lopes MACQ, Botelho RV, Petracó R, et al. Acute Coronary Syndromes in the Current Context of the Covid-19 Pandemic. *Arq Bras Cardiol*. 2020;114(6):1067-71. doi: 10.36660/abc.20200358.
- Dias RR, Santiago JAD, Madrini V Junior, Mady C, Jatene FB. Impact of COVID-19 Pandemic in a Brazilian High-Volume Aortic Center. *Braz J Cardiovasc Surg*. 2021;36(2):145-49. doi: 10.21470/1678-9741-2020-0567.

