Brief report

Impact of the COVID-19 pandemic on the use of myocardial perfusion imaging for the assessment of coronary artery disease: a Brazilian experience

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The COVID-19 pandemic and the lockdown period caused deep effects on healthcare, including cardiac imaging, with a possible negative influence on the evaluation of coronary artery disease (CAD). This study aimed to evaluate the impact of the COVID-19 pandemic on myocardial perfusion imaging (MPI) performance and results in a Brazilian, Nuclear Cardiology laboratory. Patients with or without known CAD who underwent MPI in three 30-day periods (pre-pandemic [mid-February to mid-March 2020], lockdown [April-May 2020], and post-lockdown [August 2020]) were studied. MPI volumes dropped from 204 pre-lockdown to 43 during lockdown (78.9% reduction), rising to 248 after lockdown. The use of pharmacologic stress increased from 36.3% to 53.5% during lockdown. The frequency of abnormal MPI tests did not differ significantly among the time intervals, as well as the frequency of myocardial ischemia. Younger age, ≥1 cardiac risk factor, and known CAD were independent predictors of the performance of MPI during the lockdown period. In conclusion, a large reduction of MPI performance occurred during lockdown, when imaging was sought mainly by younger patients, with cardiac risk factors or known CAD. There was no significant difference in the frequency of abnormal MPI or of myocardial ischemia among the periods, which might indicate missed cases of CAD during lockdown; therefore, the consequences of cardiac testing reductions should be continuously assessed.

Key words: myocardial perfusion imaging, COVID-19, pandemics, lockdown, performance, number of tests

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Introduction

Cardiovascular disease is the world´s leading cause of death (1). In Brazil, coronary artery disease (CAD) accounted for 12% of the deaths in 2019 (2). Thus, the diagnostic work-up for CAD is important, and myocardial perfusion imaging (MPI) has a key role in this scenario (3).

However, in 2020, healthcare faced an unprecedented challenge, the COVID-19 pandemic. Lockdowns were decreed, determining reductions of elective imaging tests (4, 5). In Italy, Nappi et al (6) reported a 70% fall in MPI studies during lockdown, from February to May 2020. In Brazil, lockdown was started in mid-March, and lasted for different time periods, at the discretion of each state. Therefore, an underdiagnosis of CAD may have occurred.

This study sought to evaluate the influence of the COVID-19 pandemic on the use of MPI for the assessment of CAD in a Nuclear Cardiology laboratory in Rio de Janeiro, Brazil.

Methods

This was a retrospective study of patients with or without known CAD who underwent MPI at a private, outpatient, Nuclear Cardiology laboratory in Rio de Janeiro, Brazil. Patients who underwent MPI were included in the study after informed consent was obtained.

Patients underwent rest/stress Tc-99m sestamibi gated SPECT in a CZT camera (Discovery 560, GE Healthcare). For rest images, 6-9 mCi of Tc-99m sestamibi were injected. Post-stress images (18-27 mCi of Tc-99m sestamibi) were obtained after treadmill exercise or pharmacologic stress with dypiridamole or dobutamine. Scan duration was 6 min for stress and 3 min for rest. Images were visually analyzed by two experienced readers, who independently registered the test results; divergences were solved by consensus.

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Clinical data were obtained from electronic medical records. Known CAD was considered as prior myocardial infarction, myocardial revascularization, or chronic/stable disease with angiographically defined, significant CAD.

The number of tests, stress modality (exercise or pharmacologic), frequency of abnormal tests, and frequency of ischemic MPI (reversible perfusion defects) or fibrosis (nonreversible perfusion defects) were registered in three time intervals: pre-pandemic (30 days, from mid-February to mid-March 2020), full lockdown (60 days, April-May 2020), and post-lockdown, after complete release of containment in Rio de Janeiro state (30 days, August 2020).

Continuous data are expressed as mean (standard deviation) and categorical data as percentage, and compared using ANOVA test or Chi-square test respectively. A multiple logistic regression analysis was performed to identify variables independently associated with performing MPI during the lockdown period. A value of $p<0.05$ was considered statistically significant.

Results

The total study population was comprised of 495 MPI studies (Fig.1): 204 pre-lockdown, 43 during lockdown, and 248 post-lockdown, characterizing a 78.9% reduction of MPI from pre-lockdown to lockdown. There was a decrease of the number of tests in March, lasting until May, followed by a gradual recovery until reaching pre-pandemic numbers in August.

Table 1. Clinical characteristics of patients and MPI data

Variables	Pre-lockdown (n=204)	Lockdown (n=43)	Post-lockdown (n=248)	p
Age, years	68.7 ± 11.2	62.8 ± 13.3	68.3 ± 10.3	0.006
Male, n(%)	110 (55.8)	28 (66.7)	151 (60.9)	0.3
Diagnostic test, n(%)	150 (73.5)	26 (60.5)	169 (68.1)	0.2
Known CAD, n(%)	54 (26.5)	17 (39.5)	79 (31.9)	
Diabetes, n(%)	63 (32.0)	11 (26.2)	65 (26.2)	0.38
Hypertension, n(%)	117 (59.4)	19 (45.2)	155 (62.5)	0.1
Dyslipidemia, n(%)	82 (41.6)	15 (35.7)	105 (42.3)	0.7
Family history, n(%)	51 (25.9)	10 (23.8)	59 (23.8)	0.8
Pharmacologic stress, n(%)	74 (36.3)	23 (53.5)	81 (32.7)	0.03
Abnormal MPI, n(%)	43 (21.1)	8 (18.6)	55 (22.2)	0.8
Ischemia, n(%)	12 (5.9)	2 (4.7)	25 (10.4)	0.2
Fibrosis, n(%)	16 (7.8)	4 (9.3)	17 (6.9)	0.8

Variables are presented as n (%) or mean (SD)
CAD - coronary artery disease, MPI - myocardial perfusion imaging

Table 1 depicts the characteristics of the patients undergoing MPI in the three time periods. During lockdown, patients were younger, and pharmacologic stress was mostly used. There was no difference in the indication for the MPI test (diagnostic, for suspected CAD, or for the assessment of known CAD). Also, the frequency of abnormal MPI, as well as the proportion of tests with ischemia or fibrosis, were not significantly different among the groups. Considering the number of abnormal MPI tests pre-lockdown (204) and the number during lockdown (8), the percentage of "missing" abnormal tests was of 81%.

The logistic regression analysis showed that age (OR=11.4, $p<0.001$), the presence of at least 1 cardiac risk factor (OR=4.4, $p=0.036$), and known CAD (OR=5.27, $p=0.02$) were independent predictors of the performance of MPI during the lockdown period, with an inverse association with age ($\beta= -0.053$).

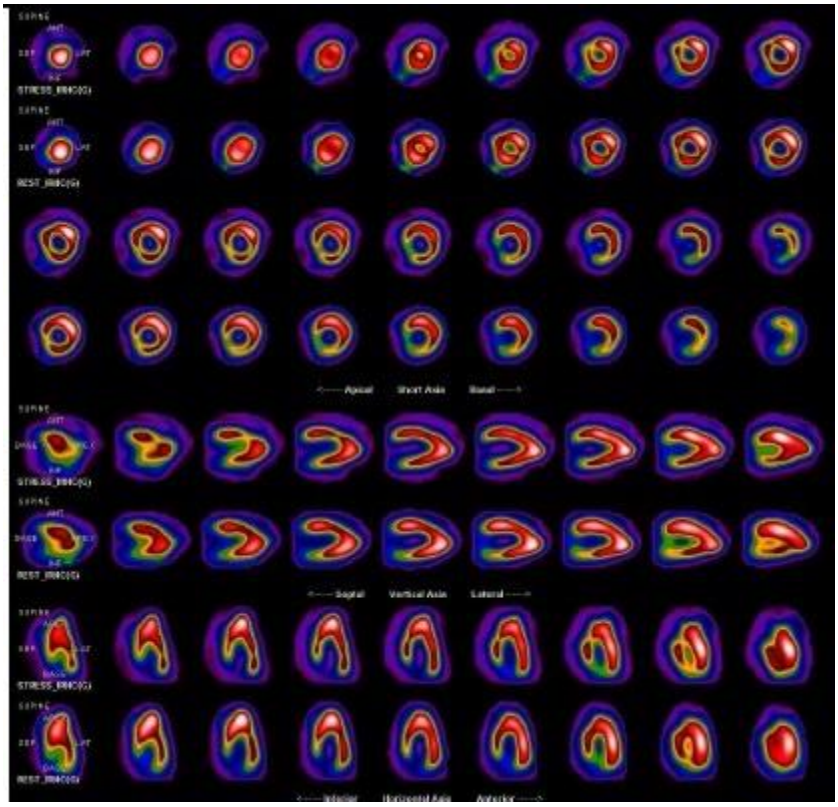

Figure 1. Stress/rest myocardial perfusion SPECT of a patient with suspected coronary artery disease

Discussion

The COVID-19 pandemic caused deep effects on healthcare, with reductions in the access to consultations, tests, and treatments. As MPI has a well-established role in the evaluation of CAD, missed diagnoses might have occurred. A multinational survey conducted by the International Atomic Energy Agency showed that cardiac diagnostic procedure volumes decreased by 64 % from March 2019 to April 2020, with the greatest regional decreases in the Middle East and Latin America, and with a decrease of nuclear stress tests by 73% (6).

To our knowledge, this is the first report of the performance of MPI in a Nuclear Cardiology laboratory in Brazil. We found a 79% drop in the number of MPI studies during the full lockdown period, compared to the previous month. Nappi et al (8) reported a reduction in MPI studies in Italy in 2020 from approximately 400 to 123, compared to the corresponding months of years 2017-2019. Interestingly, in their study, as in ours, the percentage of abnormal MPI tests was not significantly different during lockdown when compared to other time periods, underscoring that patients with potentially abnormal imaging test might have been missed during the pandemic.

Regarding the younger age of patients who underwent MPI during lockdown, and the inverse association found at multivariable modeling, one might hypothesize that older patients would be less willing to skip containment measures to have cardiac testing. The predominance of pharmacologic stress during the lockdown period is probably a result the recommendations of medical societies, to avoid emission of possibly contaminated aerosols during exercise stress test. Finally, the associations between cardiac risk factors and known CAD with MPI during lockdown probably indicate that patients who considered themselves or were considered by their doctors to be at higher CAD risk, were more likely to overcome the fear and potential infection risks in order to search for a cardiac imaging test.

Study limitations

Conclusion

This study reinforces the perception that in current days, and possibly for a long time, there should be continued surveillance over CAD incidence and manifestations, due to potentially missed diagnoses secondary to the COVID-19 pandemic.

Ethics: Informed consent was obtained from patients before all procedures.
Peer-review: External and internal
Conflict of interest: None to declare
Authorship: A. de. L., M.M.C., V.M.S., R.SL. L. equally contributed to the management of patient and preparation of manuscript
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