O IMPACTO DA SARS-COV-2 NA ACTIVIDADE CIRÚRGICA VASCULAR NUM HOSPITAL TERCIÁRIO

THE IMPACT OF SARS-COV-2 IN VASCULAR SURGICAL ACTIVITY IN A TERTIARY HOSPITAL

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Recebido em: 31/08/2020
Aceite para publicação em: 07/05/2021

RESUMO

Introdução: A doença do coronavírus de 2019 (COVID-19) e consequente período de confinamento teve um impacto significativo no sistema nacional de saúde, com restrições em toda a actividade clínica — actividade assistencial na consulta, exames complementares de diagnóstico e número e tipo de intervenções cirúrgicas. A apreensão dos doentes em recorrer aos cuidados médicos e aos hospitais levou a admissões tardias, e na nossa percepção, a apresentações mais graves da patologia de base, nomeadamente na Isquémia Crítica de Membro (ICM). A necessidade de testar os doentes previamente a uma cirurgia não-emergente aumentou o tempo de referenciação inter- e intra-hospitalar, o que, somando à diminuição dos tempos cirúrgicos e da disponibilidade de vagas em unidades de cuidados intensivos, potencialmente prejudicou os resultados. O objectivo deste estudo é avaliar objetivamente o tipo de patologia que foi tratado durante o estado de emergência e comparar o desfecho dos procedimentos cirúrgicos com o mesmo período em 2018 e 2019.

Métodos: Foi realizada uma análise retrospectiva dos processos clínicos dos doentes submetidos a cirurgia nos meses de Março e Abril do ano de 2020 e foi feita a comparação com o mesmo período dos dois anos prévios. O *endpoint* primário foi mortalidade aos 30 dias ou intra-hospitalar. Os *endpoints* secundários foram classificação patológica e do grau de isquémia, taxa de amputação, nível de amputação, tipo de cirurgia (aberta, endovascular ou híbrida), tempo de internamento e re-intervenção.

Resultados: Foram operados 98 doentes no Período COVID (PC) comparado com 286 no Período Não-COVID (PNC). Não houve diferenças estatisticamente significativas na idade (70 anos (17–98) no PC vs. 69 (17–92) no PNC, p=.13) ou sexo dos doentes operados (76% masculino (n=74) no PC vs. 70% (n=196) no PNC, p=.26). Também não houve diferença estatisticamente significativa na mortalidade (5% (n=5) no PC vs. 5% (n=13) no PNC, p=.88). Houve uma diminuição estatisticamente significativa da cirurgia aberta (43% (n=42) no PC vs. 57% (n=164) no PNC, p=.04). Não houve diferenças significativas no tempo de internamento hospitalar (10 (0–77) dias no PC vs. 7 (0–118) no PNC, p=.6) e na taxa de re-intervenção (18% (n=18) no PC vs. 16% (n=45) no PNC, p=.58).
A Doença Arterial Periférica (DAP) correspondeu a 75% (n=73) das admissões no PC, vs. 48% (n=137) no grupo PNC (p=.02). A ICM correspondeu a 99% (n=70) das admissões por DAP no PC, vs. 93% (n=114) no PNC (p=.1), com um aumento significativo da proporção de doentes cuja apresentação na admissão foi de grau 5 ou 6 de Rutherford (81% (n=57) vs. 68% (n=77), p=.03). Houve ainda uma diminuição sem significado estatístico da taxa de amputação (35% (n=25) no PC vs. 40% (n=49) no PNC, p=.49) com um aumento não significativo da taxa de amputação *major* (52% (n=13) no PC vs. 39% (n=19) no PNC, p=.27).
O segundo grupo de patologia mais tratado foi a doença aneurismática da aorta e artérias ilíacas, mas houve uma diminuição estatisticamente significativa do número de doentes tratados (5% (n=5) no PC vs. 13% (n=36) no PNC, p=.05). Todos os aneurismas da aorta tratados durante o PC estavam em rotura (100% (n=5) vs. 42% (n=15) in the NCP, p=0.2). Não houve diferenças significativas entre os grupos na mortalidade por reparação urgente de aneurismas (60% (n=3) no PC vs. 47% (n=7) no PNC, p=.77).

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Conclusão: As restrições impostas pela COVID-19 manifestaram-se principalmente no tipo de patologia tratado e no número de doentes operados. A apresentação mais grave da patologia de base, manifestada por graus de isquémia crítica mais avançados, não aumentou a mortalidade nem se reflectiu de forma significativa nas taxas de amputação. A doença aneurismática da aorta foi a segunda patologia mais tratada, mas com uma diminuição significativa do número total de casos, sem diferença significativa na mortalidade.

Palavras-chave
COVID-19; Cirurgia Vascular; *Outcomes*

ABSTRACT

Introduction/Objectives: *The Corona Virus Disease of 2019 (COVID-19) has taken a major toll on the public health system, with restrictions in all clinical activity, from consultations and exams to number and type of surgeries. Patients apprehension to resort to medical aid and hospitals leads to late admissions and, in our perception, more severe presentations of the underlying pathology, namely, in Chronic limb threatening ischemia (CLTI). Need for testing prior to non-emergent surgery causes larger delays in the referral of patients, and this, added to the reduction of surgical times and ICU availability, potentially results in worse outcomes. The aim of this study was to objectively evaluate the type pathology that was treated during the emergency state and to compare the outcome of the surgical procedures with the same period of 2018 and 2019.*

Methods: *A retrospective analysis of the patient charts from patients submitted to surgery in the months of March and April of the year 2020 was conducted and compared to the same period on the previous two years. The primary endpoint was death at 30 days or during hospital stay and the secondary endpoints were pathology classification, grade of ischemia, amputation, amputation level, type of surgery (endovascular, conventional or hybrid), time of hospital stay and reintervention.*

Results: *There were 98 patients submitted to surgery in the COVID period (CP), compared to 286 in the Non-COVID period (NCP). There was no significant difference in the age (70 years (17–98) in the CP vs. 69 (17–92) in the NCP, p=.13) or sex profile of the patients (76% male (n=74) in the CP vs. 70% (n=196) in the NCP, p=.26). There was no statistical difference in mortality (5% (n=5) in the CP vs. 5% (n=13) in the NCP, p=.88). There was a statistically significant decrease in conventional surgery (43% (n=42) in the CP vs. 57% (n=164) in the NCP, p=.04), but no statistically significant difference in length of hospital stay(10 (0–77) days in the CP vs. 7 (0–118) in the NCP, p=.6), and reintervention (18% (n=18) in the CP vs. 16% (n=45) in the NCP, p=.58).*
PAD corresponded to 75% (n=73) of the admissions in the CP vs. 48% (n=137) in the NCP, p=.02. CLTI corresponded to 99% (n=70) of the PAD population in the CP, vs. 93% (n=114) in the NCP, p=.1, with a significant increase in the number of patients presenting with Rutherford Grades 5 and 6 (81% (n=57) in the CP, vs. 68% (n=77) in the NCP, p=.03). There was a non-significant decrease in amputation rate (35% (n=25) vs. 40% (n=49), p=.49) and increase of major limb amputation (52% (n=13) vs. 39% (n=19), p=.27).
The second most frequent pathology was aneurysmal aortic and iliac disease, but there was a statistically significant reduction in the number of patients treated (5% (n=5) in the CP vs. 13% (n=36) in the NCP, p=.05). All aortic aneurysms treated in 2020 were ruptured (100% (n=5) vs. 42% (n=15) in the NCP, p=0.2). There was no significant difference in mortality in urgent aortic aneurysm repair between groups (60% (n=3) in the CP vs. 47% (n=7) in the NCP, p=.77).

Conclusions: *COVID-19 restrictions manifested mainly in the type of pathology treated and the number of patients operated on. The gravity of the underlying pathology, manifested by more serious wounds and advanced CLTI at presentation, did not increase mortality nor was reflected on limb amputations rates. Aortic and iliac aneurismal disease was the second most common pathology treated but with a significant decrease in total number of cases and no significant difference in mortality.*

Keywords
COVID-19; *Vascular Surgery*; *Outcomes*

INTRODUCTION

The Corona Virus Disease of 2019 (COVID-19) has had a major impact in clinical practice across all areas of medical care. During the initial stage of the pandemic, several countries saw their elective surgical activity restricted, with one study estimating that 28 404 603 operations were canceled or postponed globally during the 12 weeks of the COVID-19 peak[1]. Several algorithms were proposed trying to stratify surgery timing according to underlying condition[2–4]. Recognition that patients presenting with simultaneous COVID-19 infection had significantly worse operative outcomes5 increased the concern about ideal surgical timing. For Vascular Surgery, the American College of Surgeons proposed a triage system for vascular patients[6] to help establish the urgency of the underlying pathology and to aid in decision making. During the mandatory confinement period most elective surgery in Portugal was canceled, in an attempt to reduce hospital infection rates, to preserve ICU beds to accommodate COVID-19 patients, to diminish the use of protective equipment in order to allocate it to emergency services and to increase the number of medics available to cover other critical activities during peak pandemic. Emergency service became largely dependent on COVID-19 screening, and referral even in this setting was consequently delayed. Furthermore, our general perception was that patients were reluctant to resort to medical aid, both in the emergency setting and as outpatient consultations because of concern of potential COVID-19 nosocomial infection. As a final result, patients presented later, and with more severe clinical pictures with outcomes being arguably worse. Our department is a tertiary referral center serving a population of 1.285.600 people for all vascular activity, with an added 976.019 people when considering 24/7 emergent care (as accounted in data from 2017)[7]. The purpose of this study was to evaluate surgical activity in our department, during the national emergency state and to compare it with the same period of the prior two years in order to conclude on whether the clinical presentations were different and if outcomes had changed.

MATERIAL AND METHODS

The authors declare that they have followed the protocols of their center on the publication of patient data and comply with the Helsinki declaration on research ethics.

A retrospective analysis of the patient charts that underwent surgery in the months of March and April of the year 2020 (referred to as COVID Period – CP) was conducted and compared to the same period on the previous two years (referred to as Non-COVID Period – NCP). All of the patients admitted in this period of 2020 were through the emergency department or through urgent consultations. All patients had a COVID-19 test prior to or at the time of admission.

The primary endpoint was death at 30 days or during hospital stay and we analyzed the absolute number and proportion of patients treated per pathology (Aortic and iliac aneurismal disease – including thoracic, abdominal, iliac and thoracoabdominal aneurisms — arterio-venous malformations, cerebrovascular disease, peripheral arterial disease (PAD) of the lower limbs, PAD of the upper limbs, venous disease, deep venous system pathology, embolic acute limb ischemia – acute thrombotic limb ischemia is included in peripheral arterial disease of the lower limbs, since it is frequently difficult to adequately differentiate these acute events from those classified as chronic limb threatening ischemia due to coding — non-aneurismal aortic pathology, non-atherosclerotic arterial disease, peripheral arterial aneurysms, renal ischemia and renovascular hypertension, chronic kidney disease, tumors, vascular surgery complications, vascular trauma and visceral arterial pathology), admitted for Chronic limb threatening ischemia (grades 4 to 6 of Rutherford), submitted to amputation, amputation level (minor for toes or foot amputations, major for bellow and above the knee amputations), the type of surgery performed (endovascular, conventional or hybrid), the time of hospital stay (in days) and in-hospital re-intervention rate (any surgical procedure).

Statistical analysis was performed using the IBM SPPS Statistics 24 Software. Pearson's chi-squared test was applied to compare categorical data. The significance threshold was set at a p value of 0.05.

RESULTS

There were 98 patients submitted to surgery in the CP, compared to 286 in the NCP with 133 patients submitted to surgery in 2018 and 153 submitted to surgery in 2019. There was no significant difference in the age of the patients between groups, median 70 years (17–98) in the CP and 69 (17–92) in the NCP (p=.13). There was a predominance of male patients in both groups, with 76% (74/98) of male patients in the CP and 70% (196/282) in the NCP (p=.26). All patients were tested for COVID prior to or at the time of admission and all but one were negative. Emergent operations

were undertaken without COVID test results with presumptive precautions, with all tests being negative in those cases.

PAD of the lower limbs was the main cause of admission, corresponding to 75% (73/98) of patients admitted during the CP, compared to 48% (137/286) in the NCP, p=.02. PAD was the only pathology with a percentual and absolute increase in the CP (FIGURE 1, TABLE 1). The second most common cause of admission was Aortic and iliac aneurismal disease with 5% (5/98) of admissions in the CP compared to 13% (36/286) in the NCP, p=.05. All admissions in the CP corresponded to ruptured aneurysms, as opposed to 42% (n=15) in the NCP, p=0.2. The third most common cause was embolic Acute Limb Ischemia with 4% (4/98) of cases in the CP, similar to 6% (18/286) in the NCP, p=.4. Hemodialysis access complications also corresponded to 4% (4/98) of cases treated in the CP vs. 5% (15/286) in the NCP, p=.6. Cerebrovascular disease corresponded to 3% (3/98) of cases in the CP, a non-significant decrease from 7% (19/286) in the NCP, p=.2.

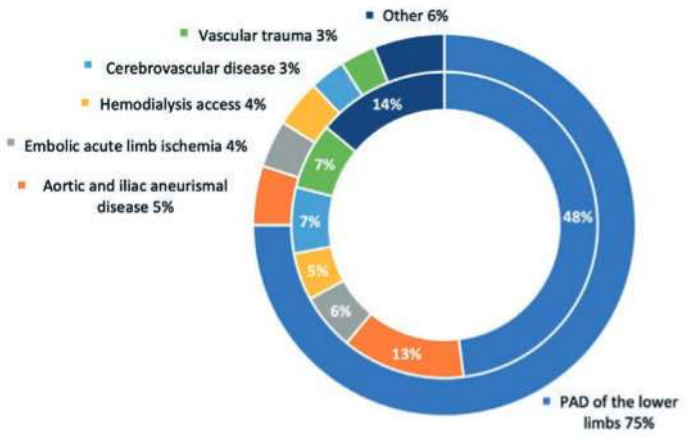

Figure 1 Patients treated according to pathology group in the CP (outer circle) and NCP (inner circle). "Other" represents groups with less than 3% of total admissions.

Among patients admitted for PAD, Chronic limb threatening ischemia (CLTI) represented 99% (70/71) of admissions in the CP, with a non-significant (p=.10) increase from 93% (114/122) in the NCP. There was however a statistically significant increase in Rutherford grades 5 and 6 at admission for patients with CLTI, with 81% (57/70) in the CP vs. 68% (77/114), p=.03 (TABLE 2).

There was no significant difference in amputation rate for patients treated with PAD, with 35% (25/71) in the CP and 40% (49/122) in the NCP, p=.49. There was a 13% increase in major amputations, 52% (13/25) of all amputations in the CP and 39% (19/49) in the NCP, which did not reach significance (p=.27).

For Aortic and iliac aneurismal disease there were no elective procedures during the CP. There were five urgent procedures, corresponding to three ruptured infrarenal abdominal aneurysms, one ruptured thoraco-abdominal aneurysm and one ruptured iliac aneurysm. There no asymptomatic patients identified with large thoracic or abdominal aneurysms (> 6.5cm) that needed urgent repair during the CP. Three patients underwent EVAR and two open surgery. There was a 60% (3/5) mortality rate (TABLE 2) during this period, 67% (2/3) for endovascular repair and 50% (1/2) for open repair. Mortality for urgent repair in the NCP was 47% (7/15), 29% (2/7) for endovascular repair and 75% (6/8) for open repair. The percentual increase in mortality from emergent endovascular repair during CP corresponded to two patients submitted to EVAR with very advanced age (92 and 98 years old). Despite the percentual increase there were no statistically significant differences for mortality in urgent aneurysm repair between groups (p=.77 — TABLE 3). There were 36 cases of Aortic and iliac aneurismal disease in the NCP, with 15 being urgent cases and the remaining elective cases that comprised TEVAR, aorto-iliac EVAR, and FEVAR, and open surgery repairs. Mortality for elective repair in the NCP was 5% (1/21). In the urgent repair group of the NCP two ruptured thoracic and 11 infra-renal abdominal aneurysms are included, as are one ruptured EVAR graft and one primary aorto-esophageal fistula. Seven patients underwent endovascular repair and eight open repair.

In the Hemodialysis access group, in the CP all the patients were treated for life-threatening access complications. No difference was observed between the CP (4% (4/98) in the CP vs. 5% (15/286) in the NCP, p=.6) and NCP in this category.

Among the three patients admitted for Cerebrovascular disease, two had symptomatic carotid stenosis (in the 14-day therapeutic window) and one had an asymptomatic high-grade carotid stenosis.

Overall, there was a decrease in proportion of conventional open surgery, with 43% (42/98) of cases on the CP vs. 57% (164/286) in the NCP, p=.04. Conversely, both endovascular and hybrid procedures increased — endovascular from 37% (107/286) in the NCP to 48% (47/98) in the CP, and hybrid from 5% (15/286) to 9% (9/98).

In-hospital reintervention rates was 18% (18/98) of patients in the CP and 16% (45/286) in the NCP, p=.58. There was no difference in 30-day or in-hospital mortality, 5% (5/98) in the CP against 5% (13/286) in the NCP, p=.88. There was also no significant difference in length of hospital stay, with median 10 (0–77) days in the CP and 7 (0–118) days in the NCP (p=.6).

TABLE 1 Absolute number of patients treated by category. Although the proportion of patients changed, the most frequently admitted remained the same.

	CP	NCP	*p* value
PAD	75% (73/98)	48% (137/286)	**.02**
Aortic and iliac aneurismal disease	5% (5/98)	13% (36/286)	**.05**
Embolic acute limb ischemia	4% (4/98)	6% (18/286)	.4
Hemodialysis access	4% (4/98)	5% (15/286)	.6
Cerebrovascular disease	3% (3/98)	7% (19/286)	.2
Vascular trauma	3% (3/98)	7% (19/286)	.2

TABLE 2 Proportion of patients admitted with Peripheral Arterial Disease (PAD), Chronic limb threatening ischemia (CLTI) and Rutherford grades 5 and 6 in the COVID Period (CP) and Non-COVID Period (NCP). Percentage and partial and total number of patients per category is presented.

	CP	NCP	*p* value
PAD	75% (73/98)	48% (137/286)	**.02**
CLTI (vs. Claudication)	99% (70/71)	93% (114/122)	.13
Rutherford 5 & 6 (vs. Rutherford 4)	81% (57/70)	68% (77/114)	**.03**

TABLE 3 Mortality from urgent repair of aortic aneurisms in the COVID Period (CP) and Non-COVID Period (NCP). Percentage and partial and total number of patients per category is presented.

	CP	NCP	*p* value
Global mortality	60% (3/5)	47% (7/15)	.77
Endovascular mortality	67% (2/3)	29% (2/7)	.4
Open mortality	50% (1/2)	75% (6/8)	.76

DISCUSSION

As it would be expected there was a reduction in the number of patients operated on, mainly because of severe restrictions to elective activity. PAD remained the main cause of admission, but the proportion of patients admitted for PAD increased, which can be explained both by lower admissions in other pathology groups, and by a slight increase in the absolute number of patients admitted in this group. Patients admitted for PAD were almost exclusively patients in CLTI, both before and during the pandemic, but there was an increase in grades 5 and 6 of Rutherford, which supports the hypothesis that patients were presenting later with more severe clinical pictures, and extensive wounds.

All other pathology groups, including the second and third most common causes showed a significant decrease in the number of cases, and constituted mainly emergency surgical cases, as represented by ruptured aortic aneurysms (second most common cause), embolic acute limb ischemia and life-threatening hemodialysis access complications (third most common causes).

The lack of difference in the Hemodialysis access group is explained by a low number of patients submitted to routine fistula creation in our institution with most interventions being related to complications or complex hemodialysis accesses.

Concerning Cerebrovascular disease, the lack of difference between the CP and NCP is explained by similar surgical criteria in both periods.

An international survey conducted by the university of Singapore reported that 91% of physicians replied that at least some if not all elective vascular surgery in their hospitals was canceled but that 92% were still performing emergency surgery[8]. Emergency vascular surgery in the COVID-19 period was categorized by different articles[6, 9–11]. In CLTI and acute limb

ischemia, ruptured aortic aneurisms, trauma surgery, acute aortic syndromes, symptomatic carotid stenosis, acute mesenteric ischemia, symptomatic peripheral arterial aneurysms and vascular access for hemodialysis, endovascular procedures were favored over open repair whenever possible to shorten hospital and ICU stay. These data are in line with the surgical activity of our department during the same time period.

Given the increase of advanced grades of ischemia at presentation, it would be expected that a larger proportion of patients needed amputation surgery or at least reintervention, but that did not happen in our sample. Both amputation and major amputation rates had a non-statistically significant increase as did reintervention rate.

One study performed in the Netherlands with a similar design to ours reported a significant increase in patients admitted for CLTI with Rutherford grades 5 and 6 (comporting 90% of cases) but an equal increase in major limb amputations from 18 to 42%, p=.01[12]. These results were in conformity with those of another study conducted in Italy, which reported an increase in major limb amputation of 50%[13].

Elective aortic and iliac aneurismal surgery did not happen during COVID-19 period and only ruptured aneurysms underwent surgery during this time. Despite a percentual increase in mortality in urgent aortic aneurysm repair, it did not reach significance. Ruptured aneurysms correspond to emergent cases that do not need to wait for COVID test results before admission to operating room. This fact and the approach protocol for this pathology in our department can explain the absence of differences in outcomes.

Conventional surgery decreased and hybrid and endovascular surgery increased, which can be related both to the nature of the pathology treated and to the global perception that endovascular procedures carry a lesser risk of COVID-19 transmission during surgery, both because of less frequent need for general anesthesia (and as such, intubation) and the avoidance of electric thermocautery which has been shown in some reports to increase the spread of viral particles[14]. Being minimally invasive, endovascular approaches also have the advantages of a faster recovery time and less frequent need of ICU beds for post-operatory recovery and monitorization. However, length of hospital stay, and mortality also remained the same. Our results confirmed the perception that patients did arrive in more severe states of ischemia and with more severe wounds, but that did not ultimately worsen prognosis.

CONCLUSIONS

Restrictions to non-urgent care and on elective procedures during the COVID-19 emergency state in our center manifested mainly in the type of pathology treated and the number of patients operated on. CLTI corresponded to the majority of admissions, in a higher proportion than in corresponding previous periods of time. The greater severity of the underlying pathology, manifested by more extensive wounds and advanced CLTI at presentation, did not increase mortality nor was reflected on significantly more major limb amputations.

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