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Lessons Learned from the Impact of the COVID-19 Pandemic in a Vascular Surgery Department and Preparation for Future Outbreaks

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Objectives: This study aims to report the changes and adaptations of a vascular tertiary center during a global pandemic and the impact on its activity and patients.

Methods: We conducted a retrospective cohort study within the Vascular Surgery ward in Centro Hospitalar Universitário Lisboa Norte, Portugal. All data from surgical, inpatient and outpatient activity were collected from February to June 2020 and compared to the same 5-month period in 2018 and 2019. We ran a descriptive analysis of all data and performed statistical tests for the variation of procedures and admissions between February and June 2018 and the same time period in 2020.

Results: During the outbreak, our staff had to be readapted. Six nurses were transferred to COVID-19 units (out of a total of 33 nurses) while 1 of the 7 residents was transferred to an intensive care unit and 1 senior surgeon was put on prophylactic leave. In the outpatient clinic, there was an increase in the number of telemedicine consultations with a greater focus on first-time referrals and urgent cases. There was a significant increase in the total number of elective admissions whereas there were significantly less admissions from an emergency setting (+57% and -54%, respectively, $P < 0.001$). The vascular surgery team performed a total number of 584 procedures between February and June 2020 (-17.8% compared to 2018 and 2019), with a significant increase in the number of endovascular procedures ($P < 0.001$) and in the use of local and regional anesthesia ($P < 0.001$), especially in the Angio Suite (+600%, $P < 0.001$). Comparing with 2018 and 2019, the surgical team performed less outpatient procedures in early 2020. We reported a significant increase in the total number of procedures for patients with a chronic limb-threatening ischemia (CLTI) diagnosis (+21%, $P < 0.001$). We did not report significant changes in the proportion of other vascular conditions. Regarding mortality, we observed a 16% decrease in the intraoperative mortality ($P 0.67$).

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Conclusions: In this study, we assessed the impact of the COVID-19 outbreak in daily activity during the contingency period. During the outbreak, there was an overall decline in outpatient clinics and inpatient admissions. Nevertheless, and despite the restrictions imposed by the pandemic and health authorities, we managed to maintain most procedures for most vascular diseases, particularly for CLTI urgent cases, without a significant increase in the mortality rate. Stringent protective measures for patient and staff or higher use of endovascular techniques and local anesthesia are some of the successful changes implemented in the department. These learned lessons are to be pursued as the pandemic evolves with future outbreaks of COVID-19, such as the current second outbreak currently spreading through Europe.

INTRODUCTION

In January 2020, an outbreak of a novel respiratory virus, SARS-CoV-2, spread from Wuhan, China.¹ Besides the morbidity and mortality directly related to the virus, health institutions and personnel were forced to reorganize their activities and deal with the pandemic. Vascular Surgery practices were no exception, with a necessity to withhold elective activities and surgeries.² On March 18, nonessential activities were interrupted, and confinement became mandatory, as a state of emergency was declared in Portugal (Fig. 1A). Furthermore, as the hospital is a tertiary university center and one of the largest nationwide, significant changes were made to accommodate a large proportion of all COVID-19 patients, including a higher demand for intensive care unit (ICU) beds. The outbreak led to a reorganization of most hospital wards, including the vascular ward which was turned into a COVID-19 specific ICU ward. In order to

maintain activity amidst these constraints and respond to all vascular referrals, including complex patients from other regions, our department had to adapt its practice (Fig. 1B).² In accordance with health authority recommendations, surgical activity was shifted to urgent and emergent cases. These recommendations varied according to the hospital's strain in COVID-19 patients in the following months. As far as personnel organization was concerned, medical staff was divided into two teams alternating on a week-to-week basis. All members with previous ICU experience started to have specific ICU training to be called on to support COVID-19 ICUs should the hospital need further resources. One senior staff member was put on prophylactic leave and called on when deemed necessary.²

Ultimately, and as the World Health Organization reports the unpredictable course of the pandemic and as we are currently facing a second outbreak, there is great urgency in defining strategies to

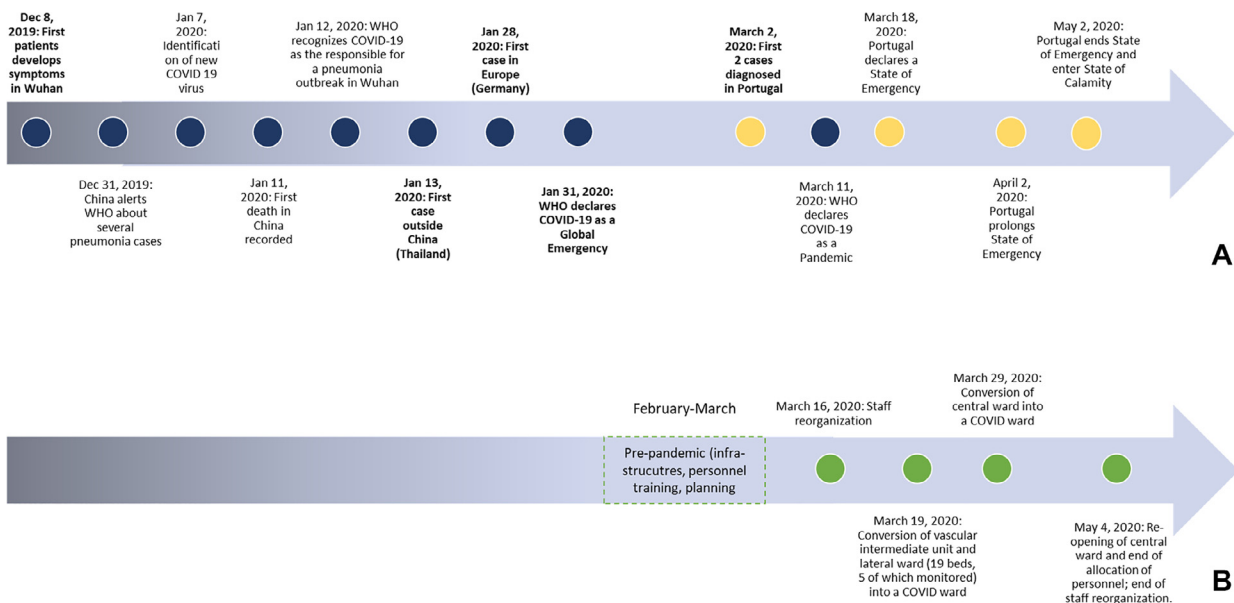


Fig. 1. COVID-19 outbreak timeline. (A) Timeline representing events worldwide (blue circles) and in Portugal (yellow circles); (B)Timeline representing the changes in the vascular surgery department. (Color version of figure is available online.)

overcome these limitations and maintain the best care for vascular patients. Moreover, we now have an opportunity to learn from the current acquired experience in order to improve care during these challenging times.

This study aims to illustrate the changes and adaptations of a vascular tertiary center during the first SARS-CoV-2 outbreak period and their impact on activity and patients. Sharing this experience, may serve as basis to learn and prepare for pandemic relapses or new world health crises.

METHODS

We conducted a retrospective cohort study within the Vascular Surgery ward in Centro Hospitalar Universitário Lisboa Norte, Lisbon, Portugal. Data from all surgical, inpatient and outpatient activity during the COVID-19 contingency period (i.e., from February to June 2020) was collected. This time period was compared to the same 5-month lapse in the 2 previous years. For each year, we collected data from surgical records regarding elective and urgent procedures for each index diagnosis (peripheral arterial disease, aneurysmal disease, aortic dissection, vascular trauma, renovascular disease, mesenteric disease, vascular hemodialysis access, venous insufficiency). For each diagnosis, we collected the total number of procedures, disease severity, anesthesia type and surgical approach. We evaluated mortality by analyzing the operative mortality rate. The ward's administrative services provided the total number of consultations and inpatient admissions during the aforementioned periods. The impact on health care providers was determined by the number of professionals reallocated to other wards and units during the COVID outbreak period and the infection rate within the ward.

We ran a descriptive analysis of all collected data and calculated the absolute variation in the number of procedures and clinical acts between the COVID-19 confinement period and the average numbers from 2018 and 2019 (i.e., non-COVID time). We also described the changes along the different times of the pandemic, with accompanying changes in patient management. When performing statistical tests to analyze this variation, we compared the numbers from 2020 to data from 2018, accounting for multiple health worker strikes in 2019 which reduced all surgical activity and could represent a potential source of bias. Continuous variables are presented as mean (standard deviation) if normally distributed and median (minimum-maximum) if not. Dichotomous and categorical

variables were expressed in numbers (percentage). Two-sample *t*-test was used when comparing continuous variables and Chi-Square/Fisher's exact test to compare dichotomous variables. All analyses were considered statistically significant if a two-tailed *P*-value <0.05 was observed. Statistical analysis was carried out using STATA 16 (StataCorp. 2019. Stata Statistical Software: Release 16. College Station, TX: StataCorp LLC).

All patients provided informed consent before treatment and Institutional Review Board approval was waived for this study.

RESULTS

Changes in Vascular Surgery Staff during the Outbreak

Our Vascular Surgery department is comprised of 20 physicians (13 vascular surgeons and 7 residents), 33 nurses and 16 nurse-assistants.

Along with the surge of new cases nationwide, we performed several changes in the Vascular Surgery ward (Fig. 1B). Namely, from March 16 to May 4 2020, the physician staff was divided into two separate teams with no communication between them. Each team was composed of half of the department physicians and worked on a 1-week-on/1-week-off basis. Furthermore, 6 nurses were transferred to COVID-19 units while 1 resident was transferred to an ICU unit and 1 senior surgeon was put on prophylactic leave. Between February and June 2020, we did not record any positive cases of SARS-CoV-2 infection among the department personnel and medical personnel were tested according to hospital policy (all ICU-assigned personnel and if contact with a patient who was later known to be SARS-CoV-2 positive and no full personal protection equipment had been used at the time of contact).

Changes in Vascular Surgery Outpatient Clinics

From 2018 to 2020, we observed a decrease of 45% in the total number of outpatient appointments. While the number of follow-up referrals decreased by 14.5%, there was a 30% relative increase in the number of first-time episodes ($P < 0.001$). Furthermore, during the COVID-19 outbreak, there was an increase in the number of telemedicine consultations (10.7% of all episodes between February and June 2020).

Table I. Baseline characteristics of the department activity between 2018 and 2020

	February–June 2018	February–June 2019	February–June 2020	Variation (%)	<i>P</i>
Surgical procedures (<i>n</i>)	785	636	584	–17.80	NA
<i>Elective</i>	606 (77.19)	466 (73.27)	449 (76.88)	–16.23	0.87
<i>Urgent</i>	179 (22.81)	170 (26.73)	135 (23.12)	–22.64	
Gender (female proportion)	27.62	28	25.36	NA	0.45
Age (mean, SD)	67.04 (13.45)	67.76 (13.54)	67.40 (13.25)	NA	0.70
Surgical approach					
<i>Open</i>	626 (79.75)	495 (77.83)	425 (72.77)	–24.17	0.002
<i>Endovascular</i>	119 (15.16)	108 (16.98)	132 (22.60)	16.30	<0.001
<i>Hybrid</i>	40 (5.09)	33 (5.19)	27 (4.63)	–26.03	0.695
Anesthesia					
<i>General</i>	635 (80.89)	510 (80.19)	415 (71.06)	–27.51	<0.001
<i>Regional</i>	17 (2.17)	15 (2.36)	14 (2.40)	–12.50	
<i>Local</i>	133 (16.94)	111 (17.45)	155 (26.54)	27.05	
Percutaneous access	82 (18.3)	70 (11.01)	104 (25.1)	36.84	<0.001
Operating rooms					
<i>Vascular OR</i>	266 (34.27)	241 (37.89)	215 (36.86)	–15.19	0.87
<i>Emergency OR</i>	179 (22.80)	168 (26.42)	135 (23.04)	–22.19	0.027
<i>Radiology OR</i>	1 (0.13)	16 (2.52)	65 (11.09)	664.71	<0.001
<i>Minor surgery OR</i>	108 (13.76)	75 (11.79)	66 (11.26)	–27.87	0.173
<i>Outpatient OR</i>	228 (29.04)	136 (21.38)	104 (17.75)	–42.86	<0.001
Inpatient admissions					
Total number	406	403	365	–9.77	NA
<i>Elective patients</i>	169 (41.63)	153 (37.97)	253 (71.67)	57.14	<0.001
<i>Admitted patients from ER</i>	237 (58.37)	250 (62.03)	112 (31.73)	–54.00	
Duration of hospitalization (days)	5 (2–14)	5 (2–13,5)	4 (2–9)	–20.00	0.004
Average preoperative duration (days)	1.86	1.38	1.19	–26.54	NA
Mortality rate (<i>n</i> (%))					
<i>Intraoperative</i>	6 (0.7)	7 (1.1)	6 (1.0)	–16.67	0.67
Outpatient consultations					
Total number	5110	4656	2684	–45.03	NA
First time	1656 (32.42)	1491 (32.02)	1129 (42.06)	–28.25	<0.001
Follow-up	3454 (67.59)	3165 (67.98)	1555 (57.94)	–53.01	
<i>Presential</i>	5110 (100)	4656 (100)	2395 (89.23)	–50.95	<0.001
<i>Telemedicine</i>	0	0	289 (10.77)	NA	

ER, emergency room; OR, operating room; Minor surgery OR, OR used for hemodialysis vascular access procedures; Outpatient OR, used for varicose vein procedures; NA, nonapplicable. Numbers between parenthesis as proportions in percentage.

Reduced Number of Hospitalizations

Our ward of 32 hospital beds was temporarily converted to a COVID-19 ICU. On March 19, 19 of those beds were reallocated for that purpose, and on the 29 the remainder were converted as well. On May 4, as the number of cases diminished, 13 beds were reattributed to vascular patients. During this time, patients were redistributed to other available departments, still under vascular care. On average and analyzing all department admissions for vascular surgery cases in the hospital, there was a reduction of 32 patients in March to 7 in April and to 17/18 in May and June (Table I).

Overall, there were 9.8% less hospitalizations during this period compared to 2018 and 2019.

During the COVID-19 outbreak, we witnessed a significant increase in the total number of elective admissions whereas there were significantly less admissions from an emergency setting (+ 57% and –54% respectively, $P < 0.001$).

Global Changes in Surgical Procedures

During the COVID-19 outbreak, the vascular surgery department performed a total number of 584 procedures (–17,8% compared to 2018 and 2019), 77% of which were performed in an elective setting (Table I). While most patients were previously treated with open surgery (72.77%) and under general anesthesia (71.06%), we observed a significant increase in the number of endovascular procedures ($P < 0.001$) and in the use of local

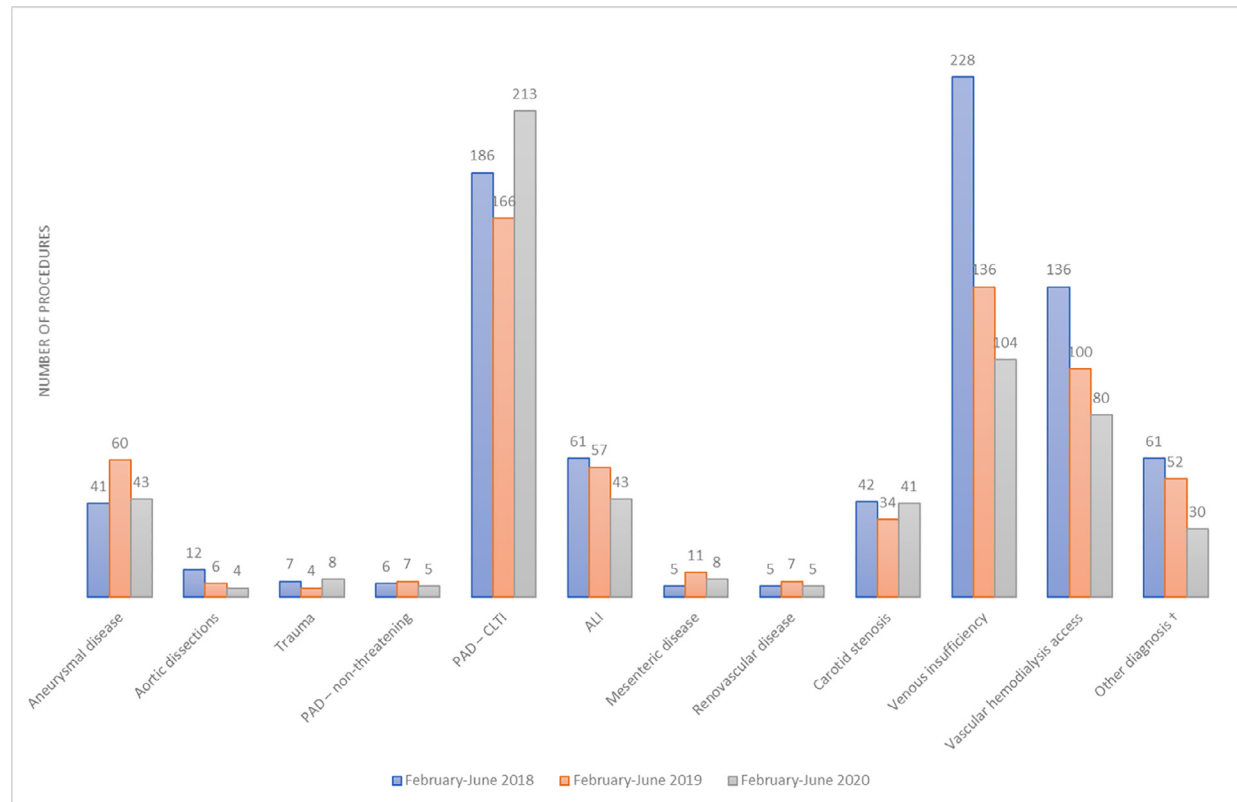


Fig. 2. Number of surgical procedures per clinical diagnosis between 2018 and 2020. ALI, acute limb ischemia; PAD, peripheral arterial disease; CLTI, chronic limb-threatening ischemia.

and regional anesthesia ($P < 0.001$). All patients operated under local and regional anesthesia wore a mask during the procedure.

Regarding outpatient clinics activity, there were significantly less procedures performed in the outpatient unit ($P < 0.001$). There was also an increase over 600% in procedures performed in the hospital's radiology Angio Suite ($P < 0.001$) by the vascular surgery team. All patients were tested for COVID-19 before any surgical procedure and admission. During the study period, we operated only on 3 patients who tested positive for SARS-CoV-2. All of these patients were operated in a dedicated OR with full protective gear. All were emergent cases: 1 vascular trauma, 1 ruptured aortic aneurysm, and 1 acute lower limb ischemia event (Rutherford 2B).

Shift in Vascular Diagnosis and Severity

Comparing the absolute number from 2018 to 2020, the surgical team performed fewer varicose vein and vascular hemodialysis access surgery (Fig. 2). In addition, we observed a significant increase in the total number of procedures for patients with a

chronic limb-threatening ischemia (CLTI) diagnosis (+21%, $P < 0.001$), while these remained stable for other indications (Table II).

However, during the study time, these numbers varied according to the evolution of the pandemic (Fig. 3). An overall decrease in all activity was seen in April, following the highest peak incidence of COVID cases. During this time, no venous and vascular hemodialysis access procedures were performed. In the following rebound months of May and June, as COVID cases stabilized and surgical activity progressively resumed, a higher number of revascularizations for CLTI were performed.

Meanwhile, we found a lower, although nonsignificant, incidence of symptomatic (both ruptured and tender) aneurysmal disease. Furthermore, there was not a significant difference in the aneurysm size in patients during the pandemic ($P = 0.44$). Regarding carotid disease, we found a reduction in the rate of symptomatic patients, although this difference was not statistically significant.

Regarding mortality, there was a 16% decrease in the perioperative and intraoperative mortality, with 67% of the intraoperative

Table II. Vascular diagnoses and disease severity of patients admitted between 2018 and 2020

	February–June 2018	February–June 2019	February–June 2020	Variation (%) ^P	
PAD	192	176	219	19.02	<0.001
CLI severity (Leriche-Fontaine)					
<i>I</i> b	6 (3.13)	7 (4.05)	5 (2.29)	−23.08	0.75 ^a
CLTI	186	166	213	21.02	<0.001
<i>III</i>	13 (6.77)	16 (9.25)	22 (10.09)	51.72	0.509 ^b
<i>IV</i>	173 (90.10)	150 (86.71)	191 (87.61)	18.27	
PAD – Surgical procedures					
Total CLI revascularizations	118	105	148	32.74	0.588
Endovascular revascularization	76	63	92	32.37	
Hybrid revascularization	25	21	23	0.00	
Open revascularization	17	21	33	73.68	
Minor amputation	64	41	43	−18.10	0.013
Major amputation	40	43	43	3.61	0.83
Revascularization: major amputation ratio	2.95	1.25	3.44	63.81	0.54
ALI	61	57	43	−27.12	0.787
ALI revascularizations	61 (100%)	57 (100%)	43 (100%)		
Aneurysmal disease (AAA TAA TAAA)	41	60	45	−10.89	0.117
Aneurysmal disease – Clinical presentation					
Mean AA diameter	6.56 6.14 6	6.97 6.97 7.17	6.58 6.5 6.95	NA	0.44
Asymptomatic	15 4 3	27 5 8	26 1 0	−12.90	0.77
Symptomatic	15 2 0	16 3 0	12 0 0	−33.33	
rAA	8 2 0	12 1 0	7 0 0	−39.13	0.9
Aneurysmal disease – Surgical procedures					
Open repair	19 0 1	21 3 1	18 0 1	−15.56	
Endovascular repair	8 6 3	22 5 4	19 1 4	0	
Hybrid repair	4 0 0	1 0 3	1 0 1	−100	
Carotid stenosis	39	34	44	20.54	0.197
Symptomatic stenosis	23 (59)	23 (69.7)	18 (40.90)	−21.74	0.1
Aortic dissections	12	6	4	−55.56	0.152
Trauma	7	4	8	45.45	0.398
Mesenteric disease	5	11	8	0.00	0.165
Renovascular disease	5	7	5	−16.67	0.75 ^a
Venous insufficiency	228	136	104	−42.86	<0.001
Vascular hemodialysis access	136	100	80	−32.20	0.71
Other diagnosis^c	61	52	30	−46.90	0.053

PAD, peripheral arterial disease; CLI, chronic limb ischemia; CLTI, chronic limb-threatening ischemia; ALI, acute limb ischemia; AAA, abdominal aorta aneurysm; TAA, thoracic aorta aneurysm; TAAA, thoracoabdominal aorta aneurysm; rAA, ruptured aorta aneurysm.

^aFisher exact test.

^bWilcoxon rank sum test.

^cOther diagnosis include graft infections, hematomas, false aneurysms, peripheral aneurysms, iatrogenic lesions, arteriovenous malformations, wound infection. NA, nonapplicable.

casualties occurring in ruptured aortic aneurysms. Nevertheless, none of these variations were statistically significant.

During the study period, we observed no in-hospital COVID-19 outbreaks (i.e., no patients with a negative SARS-CoV-2 test upon admission developed COVID-19 during their hospital stay).

DISCUSSION

The SARS-CoV-2 pandemic brought important changes to clinical practice. As this study shows, these changes were no exception in Vascular

Surgery. We were faced with a number of limitations during this time, such as shortage in hospital beds, reduced number of available operating rooms, reduced number of available staff for non-COVID patients and patients' fear to come to the hospital.

In order to overcome these limitations, we had to develop a number of adaptive strategies, which changed as the pandemic evolved.

We believe the hospital's and department protective measures, such as dividing the staff into separate "noncontact" teams, testing every patient before treatment and admission, as well as after development of any symptoms, and using a

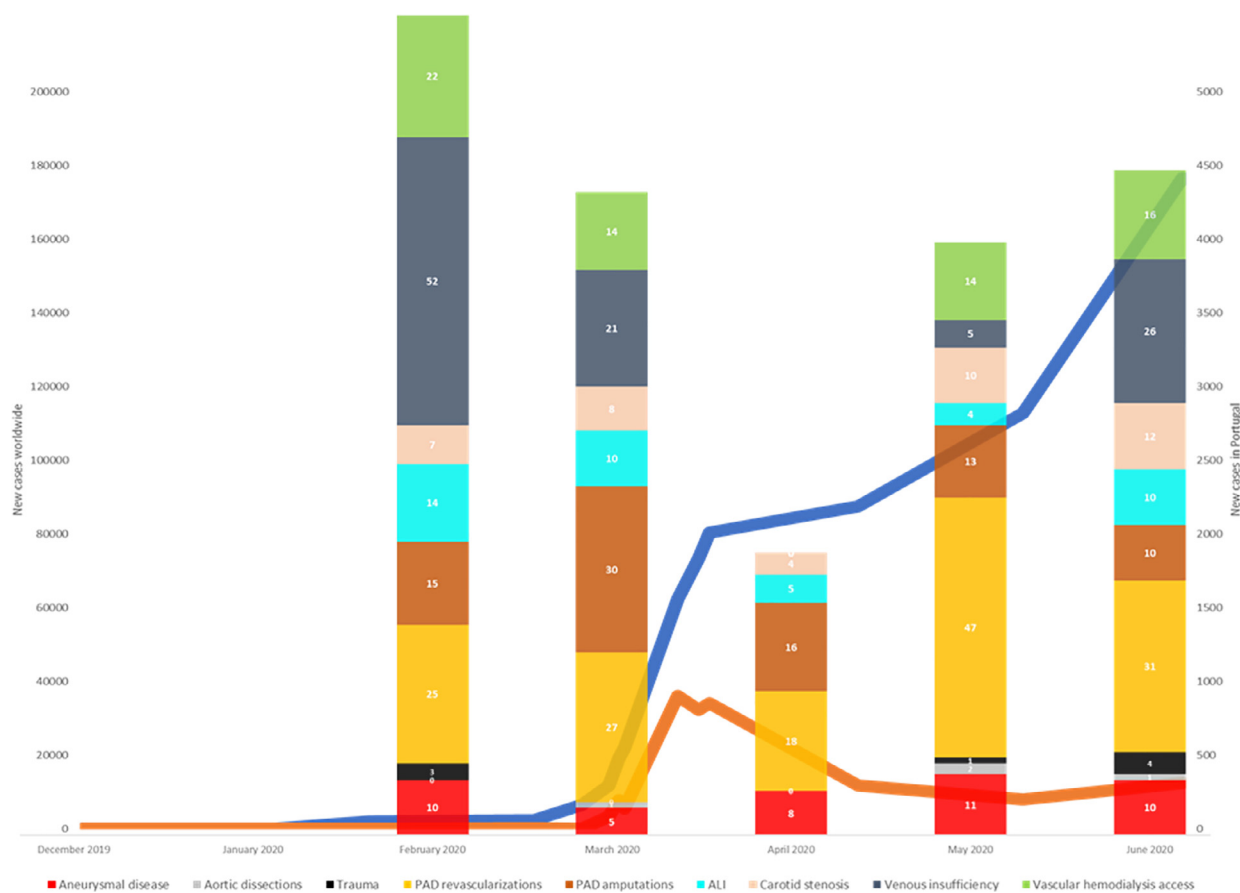


Fig. 3. Changes in surgical activity during the COVID-19 outbreak: variation of vascular procedures during the outbreak (bar chart) over the variation of new COVID-19 cases worldwide (blue line) and new COVID-19 cases in Portugal (orange line). Source: World Health Organization data table, <https://covid19.who.int/table> (as of August 25, 2020); ALI, acute limb ischemia; PAD, peripheral arterial disease. (Color version of figure is available online.)

stringent use of protective masks for everyone led to these optimal results. Indeed, we observed no in-hospital outbreak of COVID-19 in our patients or staff during the study.

Regarding outpatient clinics, since we had to reduce the number of patients, we focused on first-time referrals and urgent cases. Also, following national health authority recommendations, telemedicine appointments were more regularly implemented, especially for follow-up clinics. This strategy was a key change in general practice, allowing patients to be followed up despite the restrictions imposed by the pandemic. In Washington, Hemingway et al. reported more than half of all consults were performed in a remote setting, with the general satisfaction from both physicians and patients.³

Overall, we increased the number of endovascular procedures and implemented a more regular use of local and regional anesthesia strategies. This reflected the global concern with

a higher risk of transmission in open surgeries regarding endotracheal intubation, specially to the anesthesia team. Some of these patients were treated in the radiology department, usually with no need for an anesthesia team to be present, allowing for us to keep clinical and surgical practice going while these teams were being recruited to COVID-19 ICUs. In addition, these strategies allowed for lower lengths-of-stay and shorter procedure times, leading to more patients being treated on the same day and to a higher hospital bed rotation. This reduced both the patient's risk of contracting a hospital infection and compensated for the reduction in hospital beds.

Regarding data on peripheral arterial disease, similarly to our center, the department of vascular surgery of the Beijing Friendship Hospital reported a higher incidence and severity of PAD during the COVID-19 period, with more perioperative complications.⁴ A similar conclusion was drawn by a group of fellow surgeons in the Netherlands.

Indeed, they reported a significant increase in the number of major amputations in 2020.⁵ Surprisingly, we reported an increase in limb-salvage procedures during the pandemic time than in the 2 previous years. This might have two explanations. Since this is a referral tertiary hospital, other peripheral centers might have had more difficulty in treating these patients leading to a higher referral. Moreover, since we opted for endovascular procedures under local/regional anesthesia, and more regular use of the radiology Angio Suite, we managed to increase the number of lower limb revascularizations. We also focused more on severe PAD (peripheral artery disease) patients, such as CLTI compared to other index diagnosis such as venous disease or hemodialysis vascular accesses.

Overall, there was an expected significant drop in the number of overall admissions and procedures right after the first incidence peak of the pandemic in Portugal. However, we observed a higher incidence of elective admissions compared to urgent ones, which might be explained by a more stringent admission criteria during this period, with some CLTI urgent cases being discharged from the emergency department to their homes and called upon to be treated electively.

This led to a reduction in the length of hospital stays and an increase in bed rotation. This was a change in practice, since in the past, these patients would have been admitted and would have waited for treatment in the hospital under supervision.

In addition, the fear of viral transmission in hospital settings may explain the significant decrease in emergency admissions, as patients avoid coming into the hospital.⁶ As reported by Riley and colleagues, the COVID-19 pandemic led to a significant decrease in the number of surgical complaints, with a 61% decrease in the number of urgent vascular episodes.⁷ A shift in vascular disease severity may also account for this reduction in emergent procedures. As we presented in this study, although not significantly, less aneurysm or carotid procedures were performed in symptomatic patients. Regarding carotid disease, most symptomatic patients are referrals from the Neurology department following TIA (transient ischemic attack) or stroke. Therefore, this reduction may be due to the overall decrease of stroke diagnosis during the COVID-19 pandemic. This disturbing fact has been reported in other studies, since it might reflect the overall fear of seeking medical attention in this time-period.^{8,9} In this study, the relative increase in asymptomatic/symptomatic carotid artery disease ratio during this time is surprising. This might

be explained by the lower referral of symptomatic patients during the study time, along with resuming some elective activity in the months of May and June.

Additionally, patients with more severe conditions who avoid going to the hospital may also lead to a higher pre-hospital mortality. In this study, we observed a global decrease in the intraoperative mortality rate during the COVID-19 outbreak, which may be accounted for by higher mortality before admission, and less severe patients reaching the hospital. This hypothesis was raised by fellow surgeons at the Division of Cardiothoracic and Vascular Surgery of the New York Presbyterian Hospital, who reported a significant drop in the volume of type A aortic dissections, a disease with a high mortality burden.¹⁰ Similarly, in a recently published study on cardiovascular disease during the COVID-19 outbreak, the Nuffield Department of Population Health suggested the decline in myocardial infarction admissions may lead to a higher rate of out-of-hospital morbidity and mortality.¹¹ This is an important public-health issue to be raised and addressed, since this might lead to the overall increase in death during the pandemic due to non-COVID diagnosis (Fig. 3).¹²

This study presents several strengths. By gathering all surgical and inpatient data between February and June 2020 and 2018-2019, it offers a thorough, comprehensive scope of elective and urgent activity of a vascular surgery in a tertiary center during a global pandemic. Furthermore, by comparing data on disease severity during the first outbreak and before this period, we provide some hypotheses on how the pandemic may correlate to a shift in vascular diagnosis and practice. Lastly, the study portrays the repercussions of preparation and planning of a surgical ward during a public health crisis and provides a useful reference for further outbreaks.

There are some limitations to be pointed out. First, since all data was collected retrospectively, this study may account for some information bias. Moreover, as there are constant changes in practice and referrals in any evolving department, regardless of the pandemic, there may be some bias related to a time comparison. This study reflects the impact of the COVID-19 during the outbreak period. Nevertheless, the real outcomes and challenges may only occur in a medium to long-term basis, leaving some questions unanswered. What will be the long-term result of less outpatient clinics and follow-up, as well as less emergency admissions? Is the fear of coming to the hospital leading to a higher

Table III. Recommendations and strategies for COVID-19 upcoming outbreaks

COVID testing for all patients before surgery and admission
Reorganize medical and nursing staff (assure adequate rest, less contact between separate teams, protective measures)
Use telemedicine tools for outpatient clinics
Focus presential outpatient clinics on first referrals and urgent cases
Avoid long LOS (higher bed rotation)
Focus on more severe diagnosis (symptomatic carotid stenosis with >50% diameter, abdominal aortic aneurysms with a mean diameter higher than 5.5 cm and chronic limb-threatening ischemia patients with a high risk of amputation)
Whenever possible, perform more endovascular procedures
Perform more procedures under local or regional anesthesia
Perform public-health campaigns to discourage patients' fear of coming to the hospital for severe conditions
Create clear established protocols for protective equipment, staff management, referrals, surgical procedures
Audit results and readapt measures whenever necessary

LOS, lengths of stay.

out-of-hospital mortality for vascular diseases, such as aneurysms, dissections, stroke, and acute limb ischemia?

Lastly, this pandemic is remarkably unpredictable and in spite of all adaptations that may have been brought to the department. Even though we may be prepared to perform the best care to vascular patients, the severity and outcomes of future outbreaks of COVID-19 cannot be fully ascertained.

CONCLUSIONS

In this study, we assessed the impact of the COVID-19 outbreak in our daily activity during the contingency period. During the outbreak, there was an overall decline in outpatient clinics and inpatient admissions. Furthermore, there was a significant decrease in emergency admissions and procedures. While we performed less invasive surgery, we found a shift in vascular diagnosis, with an increase in disease severity in PAD. Nevertheless, and despite the restrictions imposed by the pandemic and health authorities, we managed to maintain overall surgical activity for most vascular diseases, without a significant increase in the mortality rate. Strategies and recommendations that led to this goal included stringent protective measures for patient and staff, higher use of endovascular techniques and local anesthesia, higher hospital bed rotation, implementation of telemedicine strategies, and a higher focus on more severe diagnoses (Table III).

This study provides major insights to understand the repercussions of a pandemic in this surgical field and how to adapt surgical activity in times of a health crisis. These learned lessons are to be pursued as the pandemic evolves with future outbreaks of

COVID-19, such as the current second outbreak spreading currently through Europe.

AUTHOR CONTRIBUTIONS

AD, RGM and LMP conceived the idea for the study and made the main contribution to planning and preparation of timelines for completion. AD, RGM, AL, JR and JV extracted all the data from hospital records and databases. AD and RGM performed the statistical analysis. LMP analyzed the data and confirmed the statistical analysis. AD designed the tables and wrote the first draft of the manuscript, which was then reviewed and amended by RGM and LMP. All authors then approved the final written manuscript. LMP is the guarantor for the work.

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