ORIGINAL ARTICLE

MAINTAINING VASCULAR ACCESS RESPONSE IN A SEVERELY COVID-19 HIT COUNTRY

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Abstract

Introduction: *The COVID-19 pandemic has caused an unprecedented disruption in healthcare systems worldwide, and Portugal was no exception. We analyze the impact of the COVID-19 pandemic in activity of our Vascular Access Center (Grupo Estudos Vasculares - GEV).*

Material and methods: *This is a retrospective study, during March 2019 and February 2021. An analysis of surgical and appointments records in 2,495 patients from 25 hemodialysis centers followed by GEV was performed. Patients were divided into two periods: non-pandemic (NPP) (March 2019 to February 2020) and pandemic periods (PP) (March 2020 to February 2021). The number of surgeries and appointments were analyzed per month and per week. The number of thrombosis were analyzed in both periods.*

Normality was tested by the Shapiro-Wilk test and by the Lilliefors (Kolmogorov-Smirnov) test. Comparisons were made by the t-test (paired samples) when normality was not rejected and by the Wilcoxon test otherwise. All the variables (normal or otherwise) were described by the usual descriptive measures such as the mean, median and quartiles.

No categorical data were collected.

To avoid COVID-19 infection a set of measures were created: Sars-cov-2 PCR test for every patient, individual protection equipment for staff, rotating teams and schedules, and only one patient allowed in the circuit to the intervention room. A descriptive statistical analysis was performed with SPSS version28. The statistical significance was confirmed for p-value < 0.05..

Results: *A total of 1756 surgeries and 800 appointments were made in both PP and NPP. Comparing the periods, we performed 914 (52%) interventions in the NPP and 842 (48%) in PP, 423 (53%) consultations in NPP and 377 (47%) at PP. Comparing the NPP and PP by months we observed more appointments in the NPP ($p=0.004$). However, the difference in the number of surgeries did not reach statistical significance ($p=0.533$). There were more thrombosis during the summer and fall in the NPP and PP. A total of 138 in NPP and 131 in PP thrombosis were observed in the 2 years period. There was no record of COVID-19 infections between all GEV staff ($n=25$).*

Conclusion: *Due to timed and tight set of measures taken in the pandemic lockdown by GEV, a similar clinical and surgical activity regarding hemodialysis patients was obtained in both periods (PP and NPP). The hypothesis that the PP could diminish vascular access assessment/intervention or more thrombosis could occur was not verified at our institution. The set of measures established to deal with the COVID-19 pandemic was also effective to prevent infection in staff members*

Keywords: *Vascular access; Hemodialysis; COVID-19; Arteriovenous fistula; Pandemic.*

INTRODUCTION

Coronavirus disease 2019 (COVID-19) is caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). It first appearance was in Hubei in China and spread all around the world causing an unprecedented disruption in healthcare systems worldwide, and Portugal was no exception.

Dialysis patients are more vulnerable and susceptible to severe COVID-19 infection due to multiple comorbidities and hemodialysis vascular access care has a profound impact on the patient's dialysis and quality of life.

The number of patients with end-stage renal disease is increasing and the majority require hemodialysis (HD).

To perform hemodialysis, patients need to have functional vascular access. For that, there are three options:

arteriovenous fistula, arteriovenous graft and central venous catheter.

The best choice is the arteriovenous fistula because it is associated with higher patency rates and lower mortality in comparison with the other two.

However, arteriovenous fistulas have complications such as thrombosis, stenosis and skin infections that can affect the quality of hemodialysis.

When these complications occur, a quick and effective surgical treatment is necessary to maintain vascular access.

At GEV (Grupo de Estudos Vasculares) in Portugal, several measures were taken to provide care to HD patients despite the appearance of COVID-19. GEV has been operating since 2011 and its focus is the management of vascular access for hemodialysis. It covers about 25 hemodialysis centers (from private clinics to hospitals) and ends up managing a total of 2495 patients. Our group is composed of 6 vascular surgery specialists, 7 vascular surgery residents, 3 anesthetists 6 nurses and 3 radiology technicians. This work aims to show the response given to our patients and how we achieved it.

MATERIALS AND METHODS

A single-center retrospective analysis of surgeries and appointments was performed between the period of March 2019 and February 2021.

The cases were divided into pandemic and non-pandemic periods (always referring to the Portuguese situation). The non-pandemic period (NPP) comprehends the time between March 2019 to February 2020 and the pandemic period (PP) was from March 2020 to February 2021.

The data selected from surgical records for statistical analysis was related to primary arteriovenous fistula (AVF) construction, AVF surgical and endovascular revision, AVF thrombosis and thrombectomy.

The statistical analysis was performed with SPSS version 28 and the statistical significance was obtained for p-value < 0.05.

To check if there was an impact care of our patients, both periods (NPP and PP) were compared by month and by number of cases per week.

A descriptive analysis of procedures was also performed.

Normality was tested by the Shapiro-Wilk test and by the Lilliefors (Kolmogorov-Smirnov) test. Comparisons were made by the t-test (paired samples) when normality was not rejected and by the Wilcoxon test otherwise. All the variables (normal or otherwise) were described by the usual descriptive measures such as the mean, median and quartiles (See tables 1 and 2).

No categorical data were collected.

A set of measures were created to ensure the safety of GEV professionals and patients to avoid COVID-19 infection.

The measures were: SARS-CoV-2 PCR test in the prior 24-72hours for patients who need interventional

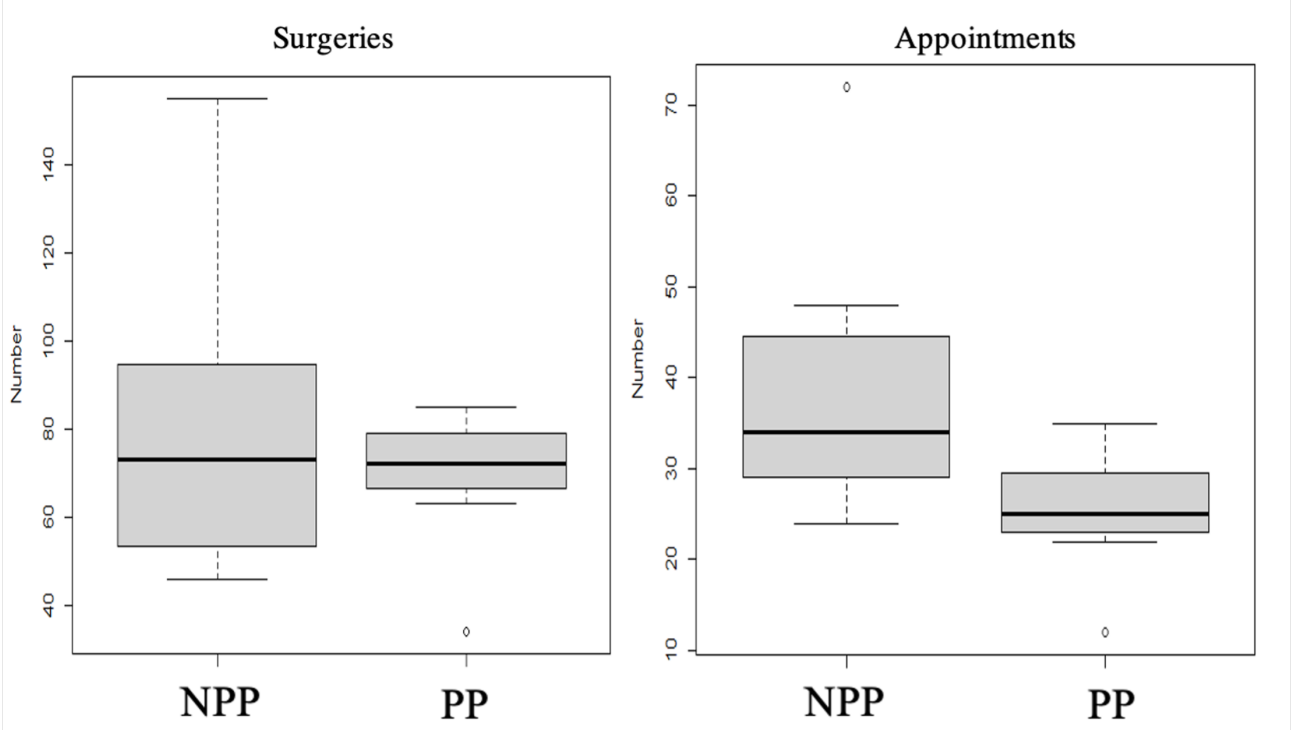

Figure 1 *Box plot distribution per months of surgeries (left) and appointments (right) at NPP and PP.*

care (except if prior infection in the last 90 days and asymptomatic), adequate individual protection equipment for consultation and interventions and masks (FFP2 or KN95) for all professionals and patients, rotative schedules and only one patient was allowed in the operating room circuit.

RESULTS

A total of 1756 surgeries and 800 appointments were made in the 2 years comprehending the pandemic and non-pandemic periods.

A comparison of both periods showed that we performed 914 (52%) interventions in the NPP and 842 (48%) in PP, 423 (53%) appointments in NPP and 377 (47%) in PP.

Comparing the NPP and PP by months we observed more appointments in the NPP with a mean value of 38.3 appointments per month in NPP vs 25.4 in PP (p=0.004). However, the difference in the number of surgeries did not reach statistical significance (p=0.533) (see table 1 and figure 1).

An analysis dividing the mean number of cases per week per period showed that the difference in number of surgeries was not statistically significant (p=0.278), obtaining a mean value of surgeries per week in NPP of 3.65 and 3.43 in PP. Although, there were more appointments during the NPP with a mean value of 1.77 appointments per week vs 1.25 in PP (p=0.0003) (see table 2 and figure 2).

Regarding the type of surgery, a descriptive analysis by period was performed (see table 3).

A total of 138 and 131 thrombosis were observed in NPP and PP, respectively. A discrepancy between the number of thrombosis and thrombectomy cases was noticed (124 thrombectomy procedures in both NPP and PP groups) and it is maybe related to AVF abandonment, partial/mural thrombosis with no hemodynamic impact or unsuccessful thrombectomy.

Regarding the set of measures to protect the staff, we can say that it was very effective since there was no record of COVID-19 infections among all GEV staff (n=25).

DISCUSSION

Dialysis access complications directly affect blood flow and lower the quality of dialysis. Several complications of vascular access such as thrombosis, stenosis or infection can occur. However, stenosis is reported to be the most important complication in arteriovenous fistula and arteriovenous graft[1].

In our work, the most frequent intervention was percutaneous transluminal angioplasty which means that stenosis was the most common complication.

The indication for intervention should be patient-specific rather than "group labeling"[2].

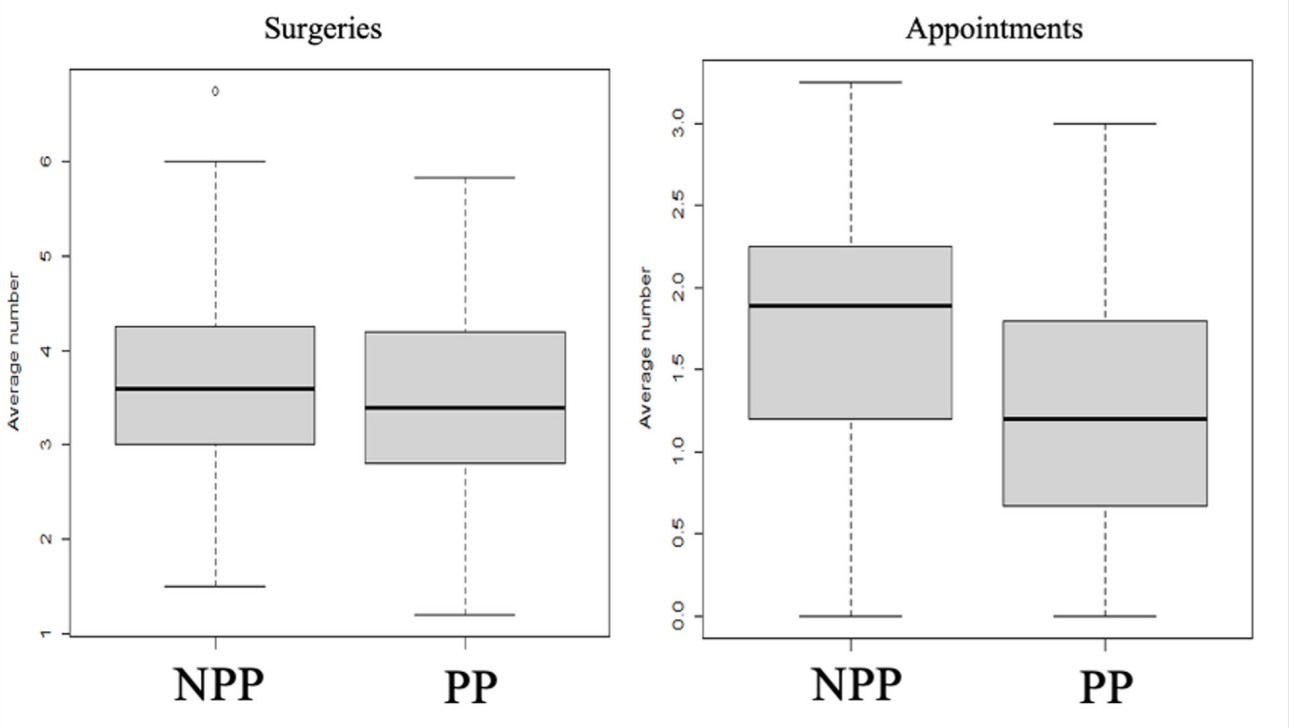

Figure 2 *Box plot distribution of average number of surgeries per week (left) and average number of appointments per week (right) at NPP and PP.*

According to the recommendations of the EUDIAL WorkingGroup for optimization of hemodialysis vascular access in the COVID-19 pandemic era, procedures that guarantee vascular access creation for patients incident to the dialysis treatment and procedures that avoid the risk of vascular access loss or serious complications should not be delayed[3].

In our practice, we decide to maintain (with the necessary precautions that were described previously) the care of our patients. With that in mind, we were able to perform 127 arteriovenous fistulas and grafts, treat 415 stenosis and 124 thrombosis in the pandemic period.

Desbuissons et al. found in their work a fatality rate of almost 50% in patients with vascular access thrombosis and this phenomenon was due to the mitigation strategies of COVID-19 pandemic[4].

Table 1 **Appointments and surgeries divided by months in Non-Pandemic Period (NPP) and Pandemic Period (PP).**

	Surgeries		Appointments	
Statistics	NPP	PP	NPP	PP
Minimum	46	34	24	12
Maximum	155	85	72	35
Q1	56	68	30	23
Mean	79	70.2	38.3	25.4
Q3	92	79	45	30
Skewness	0.95	-1.5	1.2	-0.58
Standard deviation	31.5	13.3	13.2	5.8
Coefficient of variation (%)	39.9	19.0	34.5	22.8
p-value	2 (4%)		0 (0%)	

Appointments and surgeries divided by months in Non-Pandemic Period (NPP) and Pandemic Period (PP).

Table 2 **Surgeries and appointments per week at Non-Pandemic Period (NPP) and Pandemic Period (PP).**

	Surgeries		Appointments	
Statistics	NPP	PP	NPP	PP
Minimum	1.50	1.20	0.00	0.00
Maximum	6.75	5.83	3.25	3.00
Q1	3.00	2.80	1.20	0.67
Mean	3.65	3.43	1.77	1.25
Q3	4.25	4.20	2.25	1.80
Skewness	0.27	0.05	-0.25	0.49
Standard deviation	1.08	1.05	0.78	0.73
Coefficient of variation (%)	29.7	30.7	43.9	58.7
p-value	0.278		0.0003	

Surgeries and appointments per week at Non-Pandemic Period (NPP) and Pandemic Period (PP).

Table 3 **Number of surgeries divided by type and period. AVF: Arteriovenous fistula; PTA: Percutaneous Transluminal Angioplasty; DEB: Drug-eluting balloon**

	Number of surgeries	
	NPP	PP
AVF revision	232	212
Primary AVF construction	154	127
PTA	399	393
PTA + Stent	25	16
DEB PTA	3	6
Thrombectomy	124	124

Number of surgeries divided by type and period.
AVF: Arteriovenous fistula; PTA: Percutaneous Transluminal Angioplasty; DEB: Drug-eluting balloon.

In our activity, we did not see a statistical significance in the number of thrombosis in the pandemic period when compared with the non-pandemic period.

Regardless the pandemic situation, GEV maintained AVF primary construction because even with COVID-19, it contributes to a higher survival rate and it could be performed safely[5,6].

We only treated patients without COVID-19 because patients with COVID-19 infection were treated in public hospitals to allow concomitant treatment of respiratory complications.

Nevertheless, the COVID-19 pandemic started to obligate many centers to close and reduce their surgeries even if patients did not have COVID-19.

Having that in mind, and following international recommendations, GEV created several measures to avoid staff and patients infection: SARS-CoV-2 PCR test in the prior 24-72h for patients who need surgical care (except if prior infection in the last 90 days and asymptomatic), individual protection equipment for consultation and masks (FFP2 or KN95) for all professionals and patients, rotative schedules to avoid cross infection between the professionals and only one patient was allowed in the operating room circuit [7-9].

These measures allowed us to maintain our surgical response in comparison to the non-pandemic period.

The number of consultations was reduced in the pandemic period but in our perspective, it was in part related to the reduction of referral by hemodialysis clinics.

At GEV, the main goal of the appointment is to evaluate if the patient needs intervention but it is required a prior evaluation from a nephrologist.

In some countries, as Spain, presential appointments were reduced by 47% and in 16,5% of centers, telemedicine was the only way to perform an appointment[10].

In our daily practice, we faced a similar situation in our vascular surgery appointments, and we know that in some cases a physical examination is crucial to diagnose vascular access complications.

Our results showed that a similar clinical and surgical activity was possible during the pandemic period, maintaining vascular access patient care that is essential for the survival and quality of life of hemodialysis patients.

CONCLUSION

Due to timed and tight set of measures taken in the pandemic lockdown by GEV, a similar clinical and surgical activity regarding hemodialysis patients was obtained in both periods (PP and NPP). The hypothesis that the PP could diminish vascular access assessment/intervention or that the number of thrombosis could increase was not verified at our institution. The set of measures established to deal with COVID-19 pandemic was also effective to prevent infection in staff members.

Conflict of Interest
We have no conflicts of interest to disclose.

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