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Beatriz Maria Silva Afonso

The challenge of Covid19 in the management
of vascular access for hemodialysis in an
universitary hospital

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DESIGNAÇÃO DA ÁREA DO PROJECTO

Enfermagem Vascular

TÍTULO DISSERTAÇÃO/MONOGRAFIA (riscar o que não interessa)

The challenge of covid19 in the management of vascular access for hemodialysis in an university hospital.

ORIENTADOR

Professor Doutor Ricardo Castro-Ferreira

COORDENADOR (se aplicável)

Doutor Leoncio José Abreu Nóbrega.

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Faculdade de Medicina da Universidade do Porto, 25/02/22

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Por último, queria agradecer aos meus orientadores por me guiarem nesta fase final e pela ajuda que me proporcionaram.

The challenge of Covid19 in the management of vascular access for haemodialysis in an university hospital

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ABSTRACT

Objectives: Chronic kidney disease prevalence has been increasing worldwide. This brings the need to deliver an effective treatment, ideally through the creation of a vascular access. During the first months of the coronavirus disease 2019 (COVID-19) pandemic healthcare systems around the world were under stress, potentially affecting the creation of vascular accesses. Therefore, the aim of this study is to report a single center experience with arteriovenous fistula (AVF) creation with the primary outcomes measured being the number of days between referral, consultation and surgery while also evaluating the impact of COVID-19 on these.

Methods: Procedures for AVF creation in a tertiary hospital between March 2017 and December 2020 were included in this study and their case records were retrospectively analysed and their data retrieved, including information regarding demographics, medical comorbidities, pre and post-surgical details.

Results: A total of 582 procedures were performed in the analyzed period and a total of 568 accesses were created (506 being made pre-COVID and 62 post-COVID). Regarding patients' characteristics, the groups were similar except for history of stroke ($p=0,044$). The period between the referral to the actual vascular surgery consultation was significantly longer for the COVID group [18 (23) days vs 28 (44) days; $p<0,001$] while the period between the consultation to the actual surgery was significantly shorter [76 (77) days vs 40 (57) days; $p<0,001$]. This resulted in significantly less time between referral to surgery in the COVID group [103 (77) days vs 88 (55) days; $p=0,008$]. There was not a significant difference between the two groups regarding the period between the surgery to the first postsurgical evaluation [35 (38) days vs 43 (32) days; $p=0,150$]. The global rate of working access was 75,4% ($n=428$) and 49,8% ($n=213$) of these were effectively cannulated. The difference between the working rate of pre-COVID (76,3%; $n=386$) and post-COVID (67,7%; $n=42$) groups was also statistically significant ($p=0,004$).

Conclusion: The ability of hospitals to adapt their resources to respond to non-COVID patients was paramount to mitigate its impact. In the institution where the study took place, the time from referral to consultation was increased significantly during the first months of COVID but the time from consultation to surgery was significantly reduced. Overall, these results show that despite the overwhelming number of COVID patients, there was a successful effort to expedite the creation of a venous vascular access.

Keywords: Arteriovenous Fistula (AVF); venous access (VA); Covid19; maturation; cannulation; referencing time.

INTRODUCTION

Chronic kidney disease (CKD) has been increasing in the general population worldwide. This may be related to the rising prevalence of several risk factors such as diabetes mellitus (DM) and hypertension (HTA). With the progression of CKD, it may be necessary to implement renal replacement therapy (RRT) for which the haemodialysis (HD) remains one of the main options. In 2017, the global prevalence of the population undergoing HD was estimated at 0.07%, which refers to approximately 5 million people, although this number can be up to 9,7 million people (1). Another important aspect is that HD is a significant financial burden on healthcare systems, being responsible for 2-3% of the healthcare budget in some countries (2, 3).

Patency and function are the main elements in the delivery of an effective treatment consisting in the creation of a vascular access (VA). Arteriovenous fistula (AVF) has been the preferred VA in HD. At comparable flow rates, AVF is associated with a lower incidence of complications, risk of death, infection, cardiovascular events, and hospitalizations when compared to the use of an arteriovenous graft (AVG) or a dialysis catheter (2, 4-7). When compared to the other options, radiocephalic AVF's are the first choice due to lower ischemia rates and preservation of proximal options in case of access failure (7). Nevertheless, a problem that has arisen is the high rate of AVF maturation failure. Failure rates described in the literature range from 9% to 70% (2, 6, 7), with some studies postulating that female gender (7), forearm location (7), age (>50 years) (8), and local anaesthesia (vs regional anaesthesia) (9) are risk factors for early failure.

Primary evaluation based on patient history and physical examination has been the cornerstone of assessment for many years. Both arterial and venous systems should be the subject of a meticulous study. Pre-surgical and/or post-surgical physical examination alone has shown to have a success rate between 70-80% in predicting an adequate AVF (2). But, as there can also be significant failure rates, efforts have been made to improve these rates. The most recent guidelines of the Kidney Disease Outcomes Quality Initiative (KDOQI) recommend the routine use of ultrasonography (US) for pre-surgical vein mapping in all patients before access creation. Despite this, institutions have proceeded independently due to the lack of concrete cost-effectiveness evidence for both routine and selective US assessment (6). It is also important to consider that the accuracy of US has been reported to be highly operator-dependent (2).

Furthermore, the world has been recently stricken with the coronavirus disease 2019 (COVID-19) pandemic that has disrupted healthcare systems capacity for a timely response in many pathologies. This may have a significant impact on the population under HD as it can limit and delay the access to an AVF. There is a lack of available evidence regarding this subject.

Therefore, the aim of this study is to primarily report a single center experience with AVF creation regarding the time elapsed between the referral date and the presurgical consultation, the presurgical consultation and surgery and between surgery and postsurgical consultation while also evaluating the impact of COVID-19 on these.

METHODS

Patient Selection

Procedures for AVF based on ICD-9 and ICD-10 codes in a tertiary hospital between March 2017 and December 2020 were included in this study and their case records were retrospectively analysed and their data retrieved. The patients were divided into two groups according to date when the procedure was made. Pre-COVID group ranged between March 2017 and March 18th 2020 (March 18th 2020 was the day that the first emergency state due to COVID-19 was declared in Portugal) and the post-COVID group from March 18th 2020 until December 2020. The present study was reported accordingly to the STROBE criteria. The study protocol was approved by the local Ethics Committee and respects the Declaration of Helsinki.

Data collection

The data was collected from the hospital patient's record system with information regarding demographics, cardiovascular comorbidities, risk factors (stroke, heart failure, coronary disease, DM, HTA, dyslipidaemia, obesity, peripheral arterial disease, and smoking at the time of the surgery), referral and vascular surgery consultation date, pre-surgical evaluation, US evaluation, date of surgery, VA configuration, date of first post-surgical evaluation, date of cannulation, access complications and last date of follow-up were retrieved.

Study Endpoints

The primary endpoints were evaluating the time elapsed between the referral date for vascular surgery and the pre-surgical consultation, between pre-surgical consultation and access creation and between access creation and first post-surgical evaluation. Furthermore, the impact of Covid-19 on primary study endpoints was also evaluated.

The secondary endpoints were the rate of working AVFs at the first post-surgical evaluation and the rate of successful cannulation.

The VA was considered as working accordingly to the first post-surgical recorded evaluation, irrespective of the timing of the evaluation. The terms mature or

functional were not used because we cannot guarantee that their definitions according to the European Society for Vascular Surgery guidelines were followed due to the retrospective nature of our work (8). The cannulation date was defined as the first date that the patient's records mentioned ongoing HD through the AVF. Re-intervention was defined as any intervention in index access, thus excluding any surgery for a new access after primary failure. Patency was defined as a working access at the last hospital evaluation, irrespective of the cannulation state.

Statistical analysis

SPSS (IBM, Version 27) was the tool used to perform the statistical analyses. Continuous variables were described as averages with standard deviation and categorical variables were described as frequency counts and percentages. The Mann-Whitney *U*-test was applied to continuous variables and the Kolmogorov-Smirnov test was used to verify the normal distribution on continuous variables. The P-value chosen to be the cut-off for statistical significance was $<0,05$.

RESULTS

A total of 582 procedures were performed between March 2017 and December 2020, with 520 (89%) in the pre-COVID period and 62 (11%) in the post-COVID period. These led to a total 568 accesses, divided in 506 in the pre-COVID period and 62 in the post-COVID period.

Table 1 summarizes patients characteristics and comorbidities in the studied population. The two groups (pre-COVID and post-COVID) were similar regarding patients' characteristics and comorbidities, except for the history of stroke ($p=0.044$). Both groups mostly consisted of male patients, with 64.4% ($n=335$) in the pre-COVID group and 53.5% ($n=33$) in the post-COVID group. The most common comorbidities in the two groups were HTA and dyslipidemia. HTA was present in 82.1% ($n=427$) of the patients in the pre-COVID group and 77.4% ($n=48$) in the post-COVID group. Dyslipidemia was present in 65.4% ($n=340$) of the patients in pre-COVID group and 58.1% ($n=36$) in the post-COVID group.

Regarding CKD etiology, the most common was DM. It was the cause for CKD in 23.3% ($n=122$) of patients in the pre-COVID group and 17.7% ($n=11$) in the post-COVID group. Other important causes were polycystic kidney disease, IgA nephropathy and HTA. In 10.1% ($n=53$) of pre-COVID patients and in 14.5% ($n=9$) of post-COVID patients, there was a multifactorial etiology. These results are shown in table 2.

The pre-surgical evaluation was complemented with US in 37.5% ($n=195$) of patients in the pre-COVID group and in 51.6% ($n=32$) of patients in post-COVID group. Over 75% of accesses in both groups were primary and the most common type was radio-cephalic with 49.6% ($n=258$) and 56.5% ($n=35$) in the pre and post-COVID groups, respectively. The information regarding the accesses is present in table 3.

The results of the primary outcomes are shown in table 4. The time in days (presented as median (interquartile range)) between the referral and the vascular surgery consultation was significantly longer in the post-COVID group when compared with the pre-COVID group (28 (44) vs 18 (23); $p<0.001$). There was also a significant difference in the days elapsed between consultation and surgery between the groups, with a shorter time in the post-COVID group (40 (57) vs 76 (77); $p<0.001$). Overall, this resulted in less days between referral and surgery in the post-COVID group (88 (55) vs 103 (77); $p=0.008$).

There was no significant difference in time between surgery and first post-surgical evaluation.

Data regarding follow-up is present in table 5. The working rate was 76.2% (n=386) in the pre-COVID group and 67.7% (n=42) in the post-COVID group and this difference was statistically significant ($p=0.004$). The cannulation rate was 39.7% (n=201) and 19.4% (n=12) in pre and post-COVID groups, respectively. The patency rate at the end of the follow-up period was 71.7% (n=363) in the pre-COVID group and 69.3% (n=43) in the post-COVID group. The main complication in the pre-COVID group was access thrombosis (10.9%; n=41). The re-intervention rate was similar in both groups.

DISCUSSION

Evidence regarding the impact of the COVID pandemic in VA creation is lacking and, analyzing the available literature, this is the first study to delve deeper into this subject. In the studied population, the time between referral and consultation increased significantly in the post-COVID group while the time between consultation and access creation decreased significantly in the same group. The first may be explained due to the fact that consultations were significantly reduced during the first months of the pandemic, thus leading to a delay in the consultation scheduling. Also, the first consultation in the post-COVID group was May 16th, nearly two months after the emergency state was declared in Portugal which further emphasizes the slow restart of consultations. Paradoxically, this may also help explain why the time between consultation and surgery was significantly lower in the post-COVID group as this meant that there were fewer overall patients in the consultations and less patients to perform surgery. There was also less patients being admitted through the emergency department. Even with a not fully functional operation theatre until the end of the summer, this allowed to expedite surgery scheduling in the post-COVID group. In the end, this allowed that the time between referral and surgery was significantly lower in the post-COVID group reflecting a successful adaptation of the hospital to the new reality.

On the other hand, the time between surgery and first postsurgical evaluation was similar between the two groups. The average period that most AVF need to mature (9) is between four to six weeks. However, in most evaluations, records only referred to the AVF as working or not working and this did not allowed a true evaluation of matured AVFs as defined by the European Society of Vascular Surgery (ESVS) (9). This evaluation can also be done six to eight weeks after surgery through physical examination or US (9). The working rate in the pre-COVID group was significantly higher when compared with the post-COVID group. This might be explained by the fact that 11,3% (n=7) of the post-COVID patients underwent surgery while admitted in the ward for other pathologies while this only happened in 1,3% (n=7) of the pre-COVID group, as these patients may not be fully stabilized to maximize AVF maturation.

In this study there was a low rate of complications and a low rate of re-interventions. This can be explained by the fact that after a successful AVF in the public

healthcare system, the responsibility for care and management of most complications belongs to private HD clinics and hospitals. This compromises the ability to truly evaluate the re-intervention rate and AVF's complications in this population. The low cannulation rate can also be explained by this healthcare organization.

The epidemiology of CKD varies according to the analyzed region. In developed countries, there is a higher incidence in elder people while in developing countries, the children are the ones significantly affected (10). The main etiologies for CKD are DM and HTA (11, 12). Specifically in this population, the main cause for CKD was DM, which was concordant with the literature. On the other hand, HTA was not the second most common cause as the literature states. There was however an important number of patients with multifactorial etiology and this can be explained by the high prevalence of CKD risk factors in developed countries (11). Also relevant, the number of indetermined CKD was high and may reflect the complexity of identifying a sole cause for CKD.

Some of the causes of CKD are inherently connected to its risk factors. This is the case of diabetic nephropathy and DM and hypertensive nephroangiosclerosis and HTA. Together with dyslipidemia, these were the most common comorbidities in this population. In Europe, 15-30% of end-stage CKD patients have DM (11). Other studies show an HTA prevalence of around 40% and a prevalence of obesity and DM of near 60% (13). In the considered population, primary glomerulonephritis, lupic nephritis and obstructive uropathy are less common causes of CKD. It is also important to consider that there is a high prevalence of concomitant multiple risk factors for CKD in these patients.

Despite AVF being the most studied type of VA and having the better outcomes, the maturation rate of vascular access can vary significantly in the literature. The majority are between 50-80% (6, 15-18). Although not directly comparable as stated above, the global working rate obtained in the present study (75.4%) is in the upper half of this interval. This is also true regarding the global patency rate obtained in the present study (71.5%) at the end of follow-up, even though it was not possible to evaluate the primary patency, assisted primary patency and secondary patency for the reasons stated above. There are several factors that can have a negative influence in access maturation, such as female gender, AVF in the lower limbs, older age, Caucasian and African ethnicities, cardiovascular diseases, DM, being institutionalized and deteriorated functional state

(19, 20). On the other hand, the presence of HTA, larger vein diameter and Asian and native American ethnicities are related to a higher probability of access maturation (20, 21). The influence of such factors in the considered population is beyond the scope of the present study.

The evaluation of an AVF is normally done solely by physical examination. However, there are some individual characteristics that can limit its accuracy such as obesity, prior cannulation and other comorbidities (22). US can be used without discretion, but it is especially useful in these cases. Other advantages include the non-invasive nature, its effectiveness and it can also be made the bed side. Disadvantages include being operator-dependent and time consuming (22). Its use in the presurgical study can help to identify morphologic and functional characteristics of the vessels in order to optimize the procedure (22). Despite this, the available literature isn't conclusive about the role of US in the presurgical evaluations and the results are mixed (22). It can also be important in the postsurgical follow up and there are studies that show that it can lead to higher maturation rates (18, 23, 24). Independent predictors of maturation in US include vascular flow, presence of stenosis, depth and diameter of AVF (18, 23). In this study, the registered use of presurgical US was relatively low, but it can be higher than the reported rate as in most cases it is performed right before surgery, and these aren't usually registered.

There are some limitations to consider in the present study. This was a single center study that limits its external validity. Also, the retrospective nature of the study implies inherent shortcomings that come from this analysis such as the inability to exclude selection bias and the incapacity to determinate a true maturation rate. During the period of the study, there was a lack of protocol in institution that the study occurred regarding pre- and post-surgery evaluation of VA patients. During the elaboration of this study, a working group of VAs was created that included a vascular surgeon and a nephrologist. This may lead to the creation of a protocol in the future and improve outcomes of VAs. Other limitation is the fact that the evaluation in the first post-surgery consultation is defined according to the surgeon preference and sometimes can be just 1-2 weeks after surgery. Considering the Clinical Practice Guidelines of the European Society for Vascular Surgery (9) most maturations occur in the first 4-6 weeks after

surgery and because of what was stated above regarding AVF evaluation, it was not possible to determine a true maturation rate. As also stated above, an important limitation to consider is the fact that in Portugal, the responsibility of the initialization and follow-up of HD and VA care belong to private institutions most of the times. This limited the ability to retrieve valuable data regarding maturation, cannulation and complications of VA created on the considered institution.

CONCLUSION

Patients with CKD usually have several comorbidities and need a variety of treatments from healthcare systems, and among them, the VA is one the most important. The ability to perform the treatments in a timely manner is paramount to the quality of life of these patients.

In the considered institution, the creation of VA was successfully expedited during the post-COVID period, although there was a delay between referral and consultation. This shorter time also did not lead to a better working rate. The global working rate and patency rate were in line with the highest reported in the literature.

The end-result of the process for successful VA creation lies in its cannulation. A timely response as well as a good pre- and post-surgery evaluation can maximize the number of effectively cannulated VAs. In the considered hospital, the creation of a working group can lead to better results and optimize this process. Further studies should be undertaken to better understand the impact of the COVID pandemic and learn how the healthcare systems can be improved.

DECLARATIONS

Conflict of Interests

The authors have no conflict of interest to disclosure.

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REFERENCES

1. Himmelfarb J, Vanholder R, Mehrotra R, Tonelli M. The current and future landscape of dialysis. *Nature Reviews Nephrology*. 2020;16(10):573-85.
2. Kosa SD, Al-Jaishi AA, Moist L, Lok CE. Preoperative vascular access evaluation for haemodialysis patients. *Cochrane Database of Systematic Reviews*. 2015(9).
3. Li PK-T, Chan GC-K, Chen J, Chen H-C, Cheng Y-L, Fan SL-S, et al. Tackling Dialysis Burden around the World: A Global Challenge. *Kidney Diseases*. 2021;7(3):167-75.
4. Tan RY, Manning M, Spurway J, Jegatheesan T, Bertram M, Phipps L, et al. Improving haemodialysis fistula maturation following early ultrasound vascular mapping: 'The Venous Preservation Scan'. *Nephrology*. 2019;24(5):550-6.
5. Zamboli P, Fiorini F, D'Amelio A, Fatuzzo P, Granata A. Color Doppler ultrasound and arteriovenous fistulas for hemodialysis. *Journal of ultrasound*. 2014;17(4):253-63.
6. Lee KG, Chong TT, Goh N, Achudan S, Tan YL, Tan RY, et al. Outcomes of arteriovenous fistula creation, effect of preoperative vein mapping and predictors of fistula success in incident haemodialysis patients: A single-centre experience. *Nephrology*. 2017;22(5):382-7.
7. Voorzaat BM, van der Bogt KE, Janmaat CJ, van Schaik J, Dekker FW, Rotmans JI, et al. Arteriovenous fistula maturation failure in a large cohort of hemodialysis patients in the Netherlands. *World journal of surgery*. 2018;42(6):1895-903.
8. Eckstein H-H. European Society for Vascular Surgery guidelines on the management of atherosclerotic carotid and vertebral artery disease. *European Journal of Vascular and Endovascular Surgery*. 2018;55(1):1-2.
9. Schmidli J, Widmer MK, Basile C, de Donato G, Gallieni M, Gibbons CP, et al. Editor's choice—vascular access: 2018 clinical practice guidelines of the European Society for Vascular Surgery (ESVS). *European Journal of Vascular and Endovascular Surgery*. 2018;55(6):757-818.
10. Ramilitiana B, Ranivoharisoa EM, Dodo M, Razafimandimby E, Randriamarotia WF. Une étude rétrospective sur l'incidence de l'insuffisance rénale chronique dans le service de Médecine Interne et Néphrologie du Centre Hospitalier Universitaire d'Antananarivo. *Pan African Medical Journal*. 2016;23(1).
11. Sanyaolu A, Okorie C, Annan R, Turkey H, Akhtar N, Gray F, et al. Epidemiology and management of chronic renal failure: a global public health problem. *Biostatistics Epidemiol Int J*. 2018;1(1):00005.
12. Padmanabhan A, Gohil S, Gadgil N, Sachdeva P. Chronic renal failure: An autopsy study. *Saudi Journal of Kidney Diseases and Transplantation*. 2017;28(3):545.
13. Kaze FF, Halle M-P, Mopa HT, Ashuntantang G, Fouda H, Ngogang J, et al. Prevalence and risk factors of chronic kidney disease in urban adult Cameroonians according to three common estimators of the glomerular filtration rate: a cross-sectional study. *BMC nephrology*. 2015;16(1):1-8.
14. Madala ND, Thusi GP, Assounga AG, Naicker S. Characteristics of South African patients presenting with kidney disease in rural KwaZulu-Natal: a cross sectional study. *BMC nephrology*. 2014;15(1):1-9.
15. Jemcov TK. Morphologic and functional vessels characteristics assessed by ultrasonography for prediction of radiocephalic fistula maturation. *The journal of vascular access*. 2013;14(4):356-63.

16. Voorzaat BM, van der Bogt KE, Janmaat CJ, van Schaik J, Dekker FW, Rotmans JI. Arteriovenous fistula maturation failure in a large cohort of hemodialysis patients in the Netherlands. *World journal of surgery*. 2018;42(6):1895-903.
17. Bylsma LC, Reichert H, Gage SM, Roy-Chaudhury P, Nordyke RJ, Fryzek J, et al. Clinical Outcomes of Arteriovenous Access in Incident Hemodialysis Patients with Medicare Coverage, 2012–2014. *American journal of nephrology*. 2019;49(2):156-64.
18. Farrington CA, Robbin ML, Lee T, Barker-Finkel J, Allon M. Postoperative ultrasound, unassisted maturation, and subsequent primary patency of arteriovenous fistulas. *Clinical Journal of the American Society of Nephrology*. 2018;13(9):1364-72.
19. Verest S, Logghe P, Claes K, Kuypers D, Fourneau I. Effect of clinical examination and anatomical location on native arteriovenous fistula maturation rate in high risk patients. *Acta chirurgica Belgica*. 2014;114(5):324-31.
20. Woodside KJ, Bell S, Mukhopadhyay P, Repeck KJ, Robinson IT, Eckard AR, et al. Arteriovenous fistula maturation in prevalent hemodialysis patients in the United States: a national study. *American Journal of Kidney Diseases*. 2018;71(6):793-801.
21. Kordzadeh A, Askari A, Hoff M, Smith V, Panayiotopoulos Y. The impact of patient demographics, anatomy, comorbidities, and peri-operative planning on the primary functional maturation of autogenous radiocephalic arteriovenous fistula. *European Journal of Vascular and Endovascular Surgery*. 2017;53(5):726-32.
22. Wong CS, McNicholas N, Healy D, Clarke-Moloney M, Coffey JC, Grace PA, et al. A systematic review of preoperative duplex ultrasonography and arteriovenous fistula formation. *Journal of vascular surgery*. 2013;57(4):1129-33.
23. Robbin ML, Greene T, Allon M, Dember LM, Imrey PB, Cheung AK, et al. Prediction of arteriovenous fistula clinical maturation from postoperative ultrasound measurements: findings from the hemodialysis fistula maturation study. *Journal of the American Society of Nephrology*. 2018;29(11):2735-44.
24. Coritsidis GN, Machado ON, Levi-Haim F, Yaphe S, Patel RA, Depa J. Point-of-care ultrasound for assessing arteriovenous fistula maturity in outpatient hemodialysis. *The journal of vascular access*. 2020;21(6):923-30.

ANNEXES

Table 1. Demographic data and Comorbidities of the Pre- and Post-covid populations

Characteristics	Pre-COVID (N=520)	Post-COVID (N=62)	p value
Male, n (%)	335 (64.4%)	33 (53.2%)	0.084
Age	65.37 ± 14.54	63.87 ± 15.89	0.322
Stroke, n (%)	95 (18.3%)	5 (8.1%)	0.044
Coronary artery disease, n (%)	96 (18.5%)	8 (12.9%)	0.280
Heart failure, n (%)	115 (22.1%)	10 (16.1%)	0.278
Peripheral obstructive arterial disease, n (%)	64 (12.3%)	10 (16.1%)	0.393
Diabetes Mellitus, n (%)	247 (47.5%)	23 (37.1%)	0.121
Hypertension, n (%)	427 (82.1%)	48 (77.4%)	0.367
Dyslipidemia, n (%)	340 (65.4%)	36 (58.1%)	0.255
Tobacco, n (%)	65 (12.5%)	9 (14.5%)	0.652
Obesity, n (%)	99 (19.0%)	8 (12.9%)	0.238

Table 2. Etiology of Chronic Kidney Disease of the Pre- and Post-COVID groups

Outcomes	Pre-COVID (N=520)	Post-COVID (N=62)
Chronic Glomerulonephritis, n (%)	17 (3.2%)	2 (3.2%)
Vasculitis, n (%)	18 (3.4%)	1 (1.6%)
Chronic Pyelonephritis, n (%)	9 (1.7%)	1 (1.6%)
Nephropathy of IgA, n (%)	32 (6.1%)	4 (6.5%)
Diabetes Mellitus, n (%)	122 (23.3%)	11 (17.7%)
Hypertension, n (%)	28 (5.3%)	4 (6.5%)
Autosomal Dominant Polycystic Kidney Disease, n (%)	53 (10.1%)	9 (14.5%)
Undetermined, n (%)	92 (17.6%)	6 (9.7%)
Multifactorial, n (%)	53 (10.1%)	9 (14.5%)
Ischemic, n (%)	6 (1.1%)	1 (1.6%)
Urologic Obstruction, n (%)	13 (2.5%)	2 (3.2%)
GESF, n (%)	5 (1.0%)	3 (4.8%)
Pharmacological	8 (1.5%)	
Amyloidosis	8 (1.5%)	
DM+ Hypertension	12 (2.3%)	
DM + Urologic Obstruction	5 (1.0%)	
Others, n (%)	43 (8.3%)	8 (13.0%)
Total, n (%)	520 (100%)	62 (100%)

GESF - segmental and focal glomerulosclerosis; DM - Diabetes Mellitus

Table 3. Vascular characteristics of the Pre- and Post-COVID population

Outcomes	Pre-COVID (n= 520)	Post-COVID (n=62)
Presurgical ultrasonography, n (%)	195 (37.5%)	32 (51.6%)
Primary AVF, n (%)	395 (76.0%)	49 (79.0%)
Location		
Radio-cephalic, n (%)	258 (49.6%)	35 (56.5%)
Brachio-cephalic, n (%)	188 (36.3%)	16 (25.8%)
Brachio-basilic, n (%)	41 (7.9%)	9 (14.5%)
Others, n (%)	19 (3.7%)	2 (3.2%)
Impossibility of Intrasurgical Construction, n (%)	14 (2.7%)	0 (0%)
Anastomosis		
Side to end, n (%)	217 (41.7%)	27 (43.5%)
Side to side, n (%)	111 (21.3%)	15 (24.2%)
End to end, n (%)	2 (0.4%)	1 (1.6%)
No information, n (%)	189 (36.3%)	19 (30.6%)
Laterality		
Left, n (%)	406 (78.1%)	48 (77.4%)
Right, n (%)	114 (21.9%)	14 (22.6%)

AVF - Arteriovenous fistula

Table 4. Primary outcomes

Outcomes	Time	p value
Referral-consultation time, days		
- Pre-COVID	18 (23)	<0.001
- Post-COVID (n=53)	28 (44)	
Consultation-surgery time, days		
- Pre-COVID	76 (77)	<0.001
- Post-COVID (n=53)	40 (57)	
Referral-surgery time, days		
- Pre-COVID	103 (77)	0.008
- Post-COVID	88 (55)	
Surgery-evaluation time, days		
- Pre-COVID	35 (38)	0.150
- Post-COVID	43 (32)	

Time presented as median (interquartile range)

Table 5. Secondary Outcomes and other follow-up data

Outcomes	Pre-COVID (n=520)	Post-COVID (n=62)	p value
Follow up time, days	597 ± 383	114 ± 59	-
Working, n (%)	386 (76.2%)	42 (67.7%)	0.004
Patent, n (%)	363 (71.7%)	43 (69.3%)	-
Cannulated, n (%)	201 (39.7%)	12 (19.4%)	-
Complications			
-Thrombosis, n (%)	41 (10.9%)	0 (0%)	
-Hemorrhage, n (%)	4 (0.8%)	0 (0%)	
-Aneurysm, n (%)	5 (1.0%)	0 (0%)	
Others	17 (3.4%)		
Re-intervention, n (%)	44 (8.5%)	4 (6.5%)	

STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Item No		Recommendation	Page No
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract <i>"Procedures for AVF creation in a tertiary hospital between March 2017 and December 2020 were included in this study and their case records were retrospectively analysed"</i>	8
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found <i>"Methods: Procedures for AVF creation in a tertiary hospital between March 2017 and December 2020 were included in this study and their case records were retrospectively analysed and their data retrieved, including information regarding demographics, medical comorbidities, pre and post-surgical details.</i> <i>Results: A total of 582 procedures were performed in the analyzed period and a total of 568 accesses were created... The period between the referral to the actual vascular surgery consultation was significantly longer for the COVID group [18 (23) days vs 28 (44) days; $p<0,001$] while the period between the consultation to the actual surgery was significantly shorter [76 (77) days vs 40 (57) days; $p<0,001$]. This resulted in significantly less time between referral to surgery in the COVID group [103 (77) days vs 88 (55) days; $p=0,008$]. There was not a significant difference between the two groups regarding the period between the surgery to the first postsurgical evaluation [35 (38) days vs 43 (32) days; $p=0,150$]. The global rate of working access was 75,4% ($n=428$) and 49,8% ($n=213$) of these were effectively cannulated. The difference between the working rate of pre-COVID (76,3%; $n=386$) and post-COVID (67,7%; $n=42$) groups was also statistically significant ($p=0,004$).</i> <i>Conclusion: In the institution where the study took place, the time from referral to consultation was increased significantly during the first months of COVID but the time from consultation to surgery was significantly reduced. Overall, these results show that despite the overwhelming number of COVID patients, there was a successful effort to expedite the creation of a venous vascular access.</i>	8
Introduction			
Background/ rationale	2	Explain the scientific background and rationale for the investigation being reported <i>Page 10 and 11 (see section): Introduction</i>	10
Objectives	3	State specific objectives, including any prespecified hypotheses <i>"Therefore, the aim of this study is to primarily report a single center experience with AVF creation regarding the time elapsed between the referral date and the presurgical consultation, the presurgical</i>	11

consultation and surgery and between surgery and postsurgical consultation while also evaluating the impact of COVID-19 on these. “

Methods			
Study design	4	Present key elements of study design early in the paper <i>“Procedures for AVF based on ICD-9 and ICD-10 codes in a tertiary hospital between March 2017 and December 2020 were included in this study and their case records were retrospectively analysed and their data retrieved. The patients were divided into two groups according to date when the procedure was made. Pre-COVID group ranged between March 2017 and March 18th 2020 (March 18th 2020 was the day that the first emergency state due to COVID-19 was declared in Portugal) and the post-COVID group from March 18th 2020 until December 2020.”</i>	12
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection <i>“Procedures for AVF based on ICD-9 and ICD-10 codes in a tertiary hospital between March 2017 and December 2020 were included in this study and their case records were retrospectively analysed and their data retrieved. The patients were divided into two groups according to date when the procedure was made. Pre-COVID group ranged between March 2017 and March 18th 2020 (March 18th 2020 was the day that the first emergency state due to COVID-19 was declared in Portugal) and the post-COVID group from March 18th 2020 until December 2020. “</i>	12
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants <i>“Procedures for AVF based on ICD-9 and ICD-10 codes in a tertiary hospital between March 2017 and December 2020 were included in this study and their case records were retrospectively analysed and their data retrieved. The patients were divided into two groups according to date when the procedure was made. Pre-COVID group ranged between March 2017 and March 18th 2020 (March 18th 2020 was the day that the first emergency state due to COVID-19 was declared in Portugal) and the post-COVID group from March 18th 2020 until December 2020.”</i>	12
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable <i>“The primary endpoints were evaluating the time elapsed between the referral date for vascular surgery and the pre-surgical consultation, between pre-surgical consultation and access creation and between access creation and first post-surgical evaluation. Furthermore, the impact of Covid-19 on primary study endpoints was also evaluated.</i> <i>The secondary endpoints are the rate of working AVFs at the first post-surgical evaluation and the rate of successful cannulation.”</i>	12
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group <i>“...their case records were retrospectively analysed, and their data retrieved.”</i>	12

Bias	9	Describe any efforts to address potential sources of bias	13
		<i>"The VA was considered as working accordingly to the first post-surgical recorded evaluation, irrespective of the timing of the evaluation. The terms mature or functional were not used because we cannot guarantee that their definitions according to the European Society for Vascular Surgery guidelines were followed due to the retrospective nature of our work (8). The cannulation date was defined as the first date that the patient's records mentioned ongoing HD through the AVF. Re-intervention was defined as any intervention in index access, thus excluding any surgery for a new access after primary failure. Patency was defined as a working access at the last hospital evaluation, irrespective of the cannulation state."</i>	
Study size	10	Explain how the study size was arrived at	12
		<i>"Procedures for AVF based on ICD-9 and ICD-10 codes in a tertiary hospital between March 2017 and December 2020 were included in this study and their case records were retrospectively analysed and their data retrieved."</i>	
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	13
		<i>"SPSS (IBM, Version 27) was the tool used to perform the statistical analyses. Continuous variables were described as averages with standard deviation and categorical variables were described as frequency counts and percentages. The Mann-Whitney U-test was applied to continuous variables and the Kolmogorov-Smirnov test was used to verify the normal distribution on continuous variables. The P-value chosen to be the cut-off for statistical significance was <0,05."</i>	
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	13
		<i>"SPSS (IBM, Version 27) was the tool used to perform the statistical analyses. Continuous variables were described as averages with standard deviation and categorical variables were described as frequency counts and percentages. The Mann-Whitney U-test was applied to continuous variables and the Kolmogorov-Smirnov test was used to verify the normal distribution on continuous variables. The P-value chosen to be the cut-off for statistical significance was <0,05."</i>	
		(b) Describe any methods used to examine subgroups and interactions	13
		<i>"SPSS (IBM, Version 27) was the tool used to perform the statistical analyses. Continuous variables were described as averages with standard deviation and categorical variables were described as frequency counts and percentages. The Mann-Whitney U-test was applied to continuous variables and the Kolmogorov-Smirnov test was used to verify the normal distribution on continuous variables. The P-value chosen to be the cut-off for statistical significance was <0,05."</i>	

		(c) Explain how missing data were addressed	
		<i>Although not mentioned in the manuscript text, analyses were restricted to patients without missing values (see Table 1). Table 1 characterizes the patient population of this study and presents the number of patients available for the estimation of each variable</i>	
		(d) If applicable, describe analytical methods taking account of sampling strategy	
		<i>Not applicable.</i>	
		(e) Describe any sensitivity analyses	
		<i>Not applicable because sensitivity analyses were not performed</i>	
Results			
Participants	13	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	14
		<i>"A total of 582 procedures were performed between March 2017 and December 2020, with 520 (89%) in the pre-COVID period and 62 (11%) in the post-COVID period. These led to a total 568 accesses, divided in 506 in the pre-COVID period and 62 in the post-COVID period."</i>	
		(b) Give reasons for non-participation at each stage	
		<i>Although not mentioned in the manuscript text, analyses were restricted to patients without missing values. All tables present the number of patients analysed.</i>	
		(c) Consider use of a flow diagram	
		<i>Not applicable.</i>	
Descriptive data	14	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	14
		<i>"Table 1 summarizes patients characteristics and comorbidities in the studied population. The two groups (pre-COVID and post-COVID) were similar regarding patients' characteristics and comorbidities, except for the history of stroke ($p=0.044$). Both groups mostly consisted of male patients, with 64.4% ($n=335$) in the pre-COVID group and 53.5% ($n=33$) in the post-COVID group. The most common comorbidities in the two groups were HTA and dyslipidemia. HTA was present in 82.1% ($n=427$) of the patients in the pre-COVID group and 77.4% ($n=48$) in the post-COVID group. Dyslipidemia was present in 65.4% ($n=340$) of the patients in pre-COVID group and 58.1% ($n=36$) in the post-COVID group."</i>	
		(b) Indicate number of participants with missing data for each variable of interest	
		<i>Note: The number of patients analysed is presented in every table</i>	

Outcome data	15	Report numbers of outcome events or summary measures <i>"The results of the primary outcomes are shown in table 4. The time in days (presented as median (interquartile range)) between the referral and the vascular surgery consultation was significantly longer in the post-COVID group when compared with the pre-COVID group (28 (44) vs 18 (23); $p<0.001$). There was also a significant difference in the days elapsed between consultation and surgery between the groups, with a shorter time in the post-COVID group (40 (57) vs 76 (77); $p<0.001$). Overall, this resulted in less days between referral and surgery in the post-COVID group (88 (55) vs 103 (77); $p=0.008$). There was no significant difference in time between surgery and first post-surgical evaluation."</i>	14/15
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included <i>"The results of the primary outcomes are shown in table 4. The time in days (presented as median (interquartile range)) between the referral and the vascular surgery consultation was significantly longer in the post-COVID group when compared with the pre-COVID group (28 (44) vs 18 (23); $p<0.001$). There was also a significant difference in the days elapsed between consultation and surgery "between the groups, with a shorter time in the post-COVID group (40 (57) vs 76 (77); $p<0.001$). Overall, this resulted in less days between referral and surgery in the post-COVID group (88 (55) vs 103 (77); $p=0.008$). There was no significant difference in time between surgery and first post-surgical evaluation."</i>	14/15
		(b) Report category boundaries when continuous variables were categorized <i>"The results of the primary outcomes are shown in table 4. The time in days (presented as median (interquartile range)) between the referral and the vascular surgery consultation was significantly longer in the post-COVID group when compared with the pre-COVID group (28 (44) vs 18 (23); $p<0.001$). There was also a significant difference in the days elapsed between consultation and surgery "between the groups, with a shorter time in the post-COVID group (40 (57) vs 76 (77); $p<0.001$). Overall, this resulted in less days between referral and surgery in the post-COVID group (88 (55) vs 103 (77); $p=0.008$). There was no significant difference in time between surgery and first post-surgical evaluation."</i>	14/15
		(d) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period <i>Not applicable.</i>	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses <i>"Data regarding follow-up is present in table 5. The working rate was 76.2% ($n=386$) in the pre-COVID group and 67.7% ($n=42$) in the post-COVID group and this difference was statistically significant ($p=0.004$). The cannulation rate was 39.7% ($n=201$) and 19.4% ($n=12$) in pre and post-COVID groups, respectively. The patency rate at the end of the follow-up period was 71.7% ($n=363$) in the pre-COVID group and 69.3%</i>	15

		<i>(n=43) in the post-COVID group. The main complication in the pre-COVID group was access thrombosis (10.9%; n=41). The re-intervention rate was similar in both groups."</i>	
Discussion			
Key results	18	Summarise key results with reference to study objectives <i>"Evidence regarding the impact of the COVID pandemic in VA creation is lacking and, analyzing the available literature, this is the first study to delve deeper into this subject. In the studied population, the time between referral and consultation increased significantly in the post-COVID group while the time between consultation and access creation decreased significantly in the same group. The first may be explained due to the fact that consultations were significantly reduced during the first months of the pandemic, thus leading to a delay in the consultation scheduling. Also, the first consultation in the post-COVID group was May 16th, nearly two months after the emergency state was declared in Portugal which further emphasizes the slow restart of consultations. Paradoxically, this may also help explain why the time between consultation and surgery was significantly lower in the post-COVID group as this meant that there were less overall patients in the consultations and less patients to perform surgery. There was also less patients being admitted through the emergency department. Even with a not fully functional operation theatre until the end of the summer this allowed to expedite surgery scheduling in the post-COVID group. In the end, this allowed that the time between referral and surgery was significantly lower in the post-COVID group reflecting a successful adaptation of the hospital to the new reality."</i>	16
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias <i>"There are some limitations to consider in the present study. study This was a single center study that limits its external validity. The retrospective nature of the study implies inherent shortcomings that come from this analysis such as the inability to exclude selection bias and the incapacity to determinate a true maturation rate. During the period of the study, there was a lack of protocol in institution that the study occurred regarding pre- and post-surgery evaluation of VA patients. During the elaboration of this study, a working group of VAs was created that included a vascular surgeon and a nephrologist. This may lead to the creation of a protocol in the future and improve outcomes of VAs. Other limitation is the fact that the evaluation in the first post-surgery consultation is defined according to the surgeon preference and sometimes can be just 1-2 weeks after surgery. Considering the Clinical Practice Guidelines of the European Society for Vascular Surgery (9) most maturations occur in the first 4-6 weeks after surgery and because of what was stated above regarding AVF evaluation, it was not possible to determine a true maturation rate. As also stated above, an important limitation to consider is the fact that in Portugal, the responsibility of the initialization and follow-up of HD and VA care belong to private institutions most of the times. This limited the ability to retrieve valuable</i>	18/19

		<i>data regarding maturation, cannulation and complications of VA created on the considered institution."</i>	
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence <i>"In the considered institution, the creation of VA was successfully expedited during the post-COVID period, although there was a delay between referral and consultation. This shorter time also did not lead to a better working rate. The global working rate and patency rate were in line with the highest reported in the literature. The end-result of the process for successful VA creation lies in its cannulation. A timely response as well as a good pre- and post-surgery evaluation can maximize the number of effectively cannulated VAs. In the considered hospital, the creation of a working group can lead to better results and optimize this process. Further studies should be undertaken to better understand the impact of the COVID pandemic and learn how the healthcare systems can be improved."</i>	20
Generalisability	21	Discuss the generalisability (external validity) of the study results <i>"There are some limitations to consider in the present study This was a single center study that limits its external validity. The retrospective nature of the study implies inherent shortcomings that come from this analysis such as the inability to exclude selection bias and the incapacity to determinate a true maturation rate. During the period of the study, there was a lack of protocol in institution that the study occurred regarding pre- and post-surgery evaluation of VA patients. During the elaboration of this study, a working group of VAs was created that included a vascular surgeon and a nephrologist. This may lead to the creation of a protocol in the future and improve outcomes of VAs. Other limitation is the fact that the evaluation in the first post-surgery consultation is defined according to the surgeon preference and sometimes can be just 1-2 weeks after surgery. Considering the Clinical Practice Guidelines of the European Society for Vascular Surgery (9) most maturations occur in the first 4-6 weeks after surgery and because of what was stated above regarding AVF evaluation, it was not possible to determine a true maturation rate. As also stated above, an important limitation to consider is the fact that in Portugal, the responsibility of the initialization and follow-up of HD and VA care belong to private institutions most of the times. This limited the ability to retrieve valuable data regarding maturation, cannulation and complications of VA created on the considered institution."</i>	18/19
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based <i><u>"Conflict of Interests"</u> The authors have no conflict of interest to disclosure.</i> <i><u>Funding Sources</u> This study received no funding from any external source."</i>	20

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*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.



ANNALS OF VASCULAR SURGERY

The International Journal of Vascular Surgery and Endovascular Therapies

AUTHOR INFORMATION PACK

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Annals of Vascular Surgery, published eight times a year, invites original manuscripts reporting clinical and experimental work in **vascular surgery** for peer review. Articles may be submitted for the following sections of the journal: Clinical Research (reports of clinical series, new drug or medical device trials) Basic Science Research (new investigations, experimental work) Case Reports (reports on a limited series of patients) General Reviews (scholarly review of the existing literature on a relevant topic) Developments in Endovascular and Endoscopic Surgery Selected Techniques (technical maneuvers) Historical Notes (interesting vignettes from the early days of vascular surgery) Editorials/Correspondence

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