A Real-World Analysis of Anti-Atherosclerotic Medical Treatment and Risk Factor Control in a Cohort of Vascular Surgery Patients in Portugal

Tratamento Médico Anti-Aterosclerótico e Controlo de Fatores de Risco numa Coorte de Doentes Vasculares em Portugal

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ABSTRACT

Introduction: The aim of this study was to assess the pattern of anti-atherosclerosis medicines in patients admitted to a vascular surgery department, the effective control of the target values and its subsequent modification by the vascular surgery team.

Material and Methods: A retrospective single-center cohort study of prospectively collected data was performed between May 2017 and May 2018 in a tertiary center. The STROBE guidelines were followed. All patients undergoing a primary elective surgery for carotid disease, aortic aneurysm and peripheral arterial disease were included. 'Best medical treatment' was defined as treatment with both anti-thrombotic and lipid-lowering treatment and, when appropriate, antihypertensive and anti-diabetic drugs. Both baseline and post-discharge best medical treatment were recorded. Blood work-up was performed at admission and 'adequately controlled patient' was defined if all blood test values were in agreement with the guidelines.

Results: A total of 279 patients (78% male; mean age 69 years-old) were included. Optimal medical therapy was registered in 58.8% upon admission but improved to 73.8% (95% CI, 2.197 – 7.781; $p < 0.001$) after discharge. At baseline, a total of 65.4% of patients were on lipid-lowering agents and of these, only 37% had LDL-C values within the targets. Likewise, only 34.6% of the 78 patients with diabetes had glycated hemoglobin within the normal range. Additionally, 8.5% of the remaining cohort had undiagnosed diabetes.

Conclusion: In our current practice, only 75% of the patients receive best medical treatment. Although the admission in a Vascular Surgery department was an opportunity to optimize medical therapy, treatment remains suboptimal in one-quarter of patients. Further efforts should be carried out to alert vascular surgeons to this problem and to find future multidisciplinary solutions that can improve the cardiovascular risk profiles of these patients.

Keywords: Atherosclerosis/treatment; Cardiovascular Diseases/treatment; Risk Factors; Vascular Surgical Procedures

RESUMO

Introdução: Este estudo pretendeu avaliar o padrão de tratamento médico antiaterosclerótico em doentes internados num serviço de cirurgia vascular, o controlo efetivo dos valores-alvo e a sua posterior modificação pela equipa vascular.

Material e Métodos: Foi realizado um estudo de coorte retrospetivo com dados coletados prospectivamente entre maio de 2017 e maio de 2018 num centro terciário. Foram seguidas as *guidelines* da STROBE e incluídos todos os doentes submetidos a cirurgias primárias eletivas para correção de doença carotídea, aneurisma de aorta e doença arterial periférica. Definiu-se como 'tratamento médico otimizado' o tratamento com fármacos anti-trombóticos e hipolipemiantes e, quando apropriado, com agentes anti-hipertensivos e antidiabéticos. Foi registado tratamento médico otimizado à entrada bem como após a alta. À admissão foi igualmente realizado um controlo analítico e os doentes foram classificados como 'adequadamente controlados' se todos os valores analíticos estivessem de acordo com as normas de orientação clínica.

Resultados: Foram incluídos 279 pacientes (78% homens; idade média de 69 anos). O tratamento médico otimizado foi registado em 58,8% à data de admissão, tendo melhorado para 73,8% (IC 95%, 2,197 – 7,781; $p < 0,001$) após alta da enfermaria vascular. No início do estudo, 65,4% dos doentes estavam sob agentes hipolipemiantes e, destes, apenas 37% tinham valores de LDL-C dentro dos valores-alvo estabelecidos pelas normas de orientação clínica. Da forma semelhante, apenas 34,6% dos 78 doentes com diabetes tinham hemoglobina glicada dentro da normalidade. Da restante coorte, 8,5% tinha diabetes não diagnosticada.

Conclusão: Na nossa prática atual apenas 75% dos pacientes seguem o tratamento médico otimizado. Apesar do internamento num serviço de Cirurgia Vascular ser uma oportunidade única para otimizar o tratamento médico, este permanece abaixo do ideal em cerca de um quarto dos doentes. Devem ser realizados esforços adicionais no sentido de alertar os cirurgiões vasculares para esse problema e encontrar soluções multidisciplinares futuras que permitam melhorar o perfil de risco cardiovascular destes doentes.

Palavras-chave: Aterosclerosis/tratamento; Doenças Cardiovasculares/tratamento; Factores de Risco; Procedimentos Cirúrgicos Vasculares

INTRODUCTION

Atherosclerotic disease (AD) is the leading cause of morbidity and mortality worldwide and is the most prevalent condition in vascular surgery patients.[1] As a polyvascular disease, it affects not only the peripheral territories but may simultaneously involve the coronary and cerebral arteries resulting in exceedingly high mortality from stroke and myocardial infarction.[2-7] Therefore, it is essential to focus on the prevention of general cardiovascular complications beyond

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the treatment of the specific vascular condition. The current medical management of cardiovascular risk factors, such as anti-thrombotic, lipid-lowering, anti-hypertensive and anti-diabetic medication [commonly designated as best medical therapy (BMT)], have shown to be effective in lowering overall and cause-specific related mortality in patients with coronary disease as well as other vascular disorders like extra-coronary atherosclerotic occlusive disease and aneurysms.[2,8-12] In observational studies, BMT has shown to be effective in reducing the risk of stroke in patients with asymptomatic carotid stenosis leading to ample discussions in the vascular and neurology communities regarding the risk of asymptomatic stenosis and the indications for intervention.[13,14] However, it remains questionable how these results from very controlled populations can be extrapolated to the real-world setting and some publications[6] suggest that a significant number of patients are not well controlled. Furthermore, being medicated does not mean adequately controlled [i.e., target LDL value, target blood pressure (BP)], an issue that has not been considered in previous studies.

Therefore, the aim of this study was to assess the medical management of a real-world cohort of vascular surgery patients, in order to: 1) assess the pattern of anti-atherosclerosis medicines in patients admitted to a vascular surgery department; 2) evaluate how adequately treated patients are effectively controlled, considering the therapeutic targets suggested by guidelines[2,3,8,10] and 3) assess the impact of the admission to the vascular surgery Department on the improvement of medical treatment for atherosclerosis. We hypothesized that most patients admitted to the hospital were not adequately medicated and not adequately controlled either. Moreover, we hypothesized that admission to the Vascular Surgery department would improve the medical treatment of these patients.

MATERIAL AND METHODS

Study design

A retrospective single-center cohort study of prospectively collected data was performed. The STROBE (StrengThening the Reporting of Observational Studies in Epidemiology) guidelines for reporting cohort studies were followed.[15]

Setting

The study was conducted from May 2017 to May 2018 in the Vascular Surgery Department of Centro Hospitalar Universitário Lisboa Norte (CHULN), a tertiary University Hospital in the center of Lisbon and one of the largest hospitals in Portugal. Data was collected prospectively using a pre-specified case report form.

Participants

All consecutive patients admitted for a primary elective surgery during the study period were included. Re-admissions, emergency cases and patients admitted through the emergency department were excluded.

Variables, data sources and measurement

A complete medical history was recorded upon admission. Patients were assessed regarding medication use (active drug, dose, duration of treatment and compliance), previous medical history (smoking, hypertension, diabetes, lower limb peripheral artery disease, carotid disease, aneurysmal disease, dyslipidemia, coronary artery disease, heart failure and chronic renal disease) and past surgical history. Past medical history was assessed by consulting the patients' clinical records. Regarding *de novo* diagnoses based on laboratory values, guideline target values[2,3,5,10] were used: hypertension was defined as office systolic BP values ≥ 140 mmHg and/or diastolic BP (DBP) values ≥ 90 mmHg; dyslipidemia was considered in patients with LDL-C > 70 mg/dL and diabetes with HbA1c > 7%. The diagnosis leading to admission and the details of the surgery were also registered.

Any modifications to the baseline medical therapy following admission in the Department were registered.

Blood work-up was performed including complete blood cell count, coagulation test including fibrinogen, total cholesterol, LDL cholesterol, HDL cholesterol, triglycerides, creatinine, urea, AST, ALT, glycated hemoglobin (HbA1c), fasting glucose, C-reactive protein (CRP) and uric acid.

Vascular procedures were divided into four groups according to the diagnosis (Index Procedures): carotid disease, abdominal aortic aneurysm (AAA), intermittent claudication (IC) and chronic limb-threatening ischemia (CLTI).

'Best medical treatment' was defined as a baseline treatment with both anti-thrombotic drugs (ATD) and statins and, when appropriate, antihypertensive and anti-diabetic agents.

A patient was considered 'adequately controlled' when the risk factor variables met the guideline target values (BP < 140/90 mmHg and in patients with diabetes DBP < 85 mmHg; LDL-C < 70 mg/dL and HbA1c < 7%).[2,3,5,10]

The effective control of ambulatory arterial hypertension was found to be difficult to assess during hospital admissions for surgery or for critical conditions and it was not included in the analysis.

Major adverse cardiovascular events (MACE) including nonfatal stroke, nonfatal myocardial infarction and cardiovascular death, were registered during the study period.

Bias

In order to lower the possibility for performance bias, only two physicians were involved in the study and collected data without interfering in day-to-day practice. Data was collected prospectively in order to deal with reporting bias. The study focused on patients with different diagnoses in order to account for some selection bias.

Statistical methods

Descriptive statistics are presented for demographic and baseline variables as absolute and relative frequencies. Continuous variables are presented as mean (standard deviation – SD) if normally distributed and median

(interquartile range – IQR) if not. Category variables are presented as frequency (percentage).

To study which variables could influence a patient to be in BMT, univariate comparisons of preoperative comorbidities were performed using the Pearson χ^2 and Fisher exact tests, the latter when the event rates were low (< 10 events). The same statistical analysis was used to study in-hospital mortality and MACE. In addition, variables with potential influence on preoperative BMT were also included in a multivariable logistic regression model. BMT rate was analyzed using a McNemar's test to compare the study group before and after admission to the Vascular Surgery Department. Statistical significance was set at $p < 0.05$. Analyses were performed using Stata version 14.0 for Mac (Stata Corp® 2015, *Stata Statistical Software: Release 14*. College Station, TX: StataCorp LP).

Ethics

Informed consent was obtained from all individual participants included in the study. Due to the sensitive nature of the questions asked in this study, survey respondents were assured the raw data would remain confidential and would not be shared. This article does not contain any studies with human participants performed by any of the authors and so the Ethic Committee approval was waived.

RESULTS

Participants and descriptive data

A total of 291 patients were electively admitted to the Vascular Surgery department during the study period for Index Procedures. Twelve patients were excluded for having missing data regarding pre-hospitalization medication. The final cohort included a total of 279 patients, 78% male

Table 1 – Baseline characteristics of 279 patients undergoing index elective procedures

		Total (n = 279)	Carotid disease (n = 74)	Intermittent claudication (n = 16)	Critical limb ischaemia (n = 129)	Aortic aneurysm (n = 60)
Gender	Female	62 (22.2%)	18 (24.3%)	2 (12.5%)	37 (28.7%)	5 (8.3%)
	Male	217 (77.8%)	56 (75.7%)	14 (87.5%)	92 (71.3%)	55 (91.7%)
Mean age, years		69.03	71.59	64.53	67.11	72.87
Smoking status	Never	117 (41.9%)	33 (44.6%)	6 (37.5%)	54 (41.9%)	24 (40.0%)
	Current	79 (28.3%)	22 (29.7%)	6 (37.5%)	40 (31.0%)	11 (18.3%)
	Former	83 (29.8%)	19 (25.7%)	4 (25.0%)	35 (27.1%)	25 (41.7%)
Hypertension	No	55 (19.7%)	13 (17.6%)	4 (25.0%)	28 (21.7%)	10 (16.7%)
	Yes	224 (80.3%)	61 (82.4%)	12 (75.0%)	101 (78.3%)	50 (83.3%)
Dyslipidemia	No	137 (49.1%)	31 (41.9%)	4 (25.0%)	81 (62.8%)	21 (35.0%)
	Yes	142 (50.9%)	43 (58.1%)	12 (75.0%)	48 (37.2%)	39 (65.0%)
Coronary artery disease	None	206 (73.8%)	58 (78.4%)	11 (68.7%)	96 (74.4%)	41 (68.3%)
	Recent MI / unstable angina	4 (1.4%)	0	0	3 (2.3%)	1 (1.7%)
	Prior MI	66 (23.7%)	15 (20.3%)	5 (31.3%)	29 (22.5%)	17 (28.3%)
	Stable angina	3 (1.1%)	1 (1.3%)	0	1 (0.8%)	1 (1.7%)
Coronary revascularization	None	228 (81.7%)	63 (85.1%)	11 (68.7%)	108 (83.7%)	46 (76.7%)
	PTCA	25 (9.0%)	5 (6.8%)	3 (18.8%)	9 (7.0%)	8 (13.3%)
	CABG	26 (9.3%)	6 (8.1%)	2 (12.5%)	12 (9.3%)	6 (10.0%)
Cerebrovascular disease	No	207 (74.2%)	27 (36.5%)	14 (87.5%)	111 (86.1%)	55 (91.7%)
	Stroke	64 (22.9%)	42 (56.8%)	2 (12.5%)	15 (11.6%)	5 (8.3%)
	TIA	8 (2.9%)	5 (6.7%)	0	3 (2.3%)	0
Diabetes	No	167 (59.9%)	48 (64.9%)	12 (75.0%)	61 (47.3%)	46 (76.7%)
	Yes - OAD	76 (27.2%)	22 (29.7%)	3 (18.7%)	39 (30.2%)	12 (20.0%)
	Yes- Insulin	36 (12.9%)	4 (5.4%)	1 (6.3%)	29 (22.5%)	2 (3.3%)
COPD	No	252 (90.3%)	65 (87.8%)	15 (93.7%)	118 (91.5%)	54 (90.0%)
	Yes	27 (9.7%)	9 (12.2%)	1 (6.3%)	11 (8.5%)	6 (10.0%)
Chronic kidney disease	No	238 (85.3%)	67 (90.5%)	16 (100.0%)	102 (79.1%)	53 (88.3%)
	Yes	24 (8.6%)	7 (9.5%)	0	11 (8.5%)	6 (10.0%)
	Yes - dyalisis	17 (6.1%)	0	0	16 (12.4%)	1 (1.7%)
Cancer	No	256 (91.8%)	69 (93.2%)	15 (93.7%)	119 (92.2%)	53 (88.3%)
	Yes	23 (8.2%)	5 (6.8%)	1 (6.3%)	10 (7.8%)	7 (11.7%)

MI: myocardial infarction; PTCA: percutaneous transluminal coronary angioplasty; CABG: coronary artery bypass graft; OAD: oral antidiabetic drugs

and the median age was 70 years old. The admission diagnosis was carotid disease in 26.5%, intermittent claudication in 5.8%, critical limb ischemia in 46.2% and aortic aneurysm in 21.5%. The prevalence of risk factors was as follows: arterial hypertension (80.3%), smoking habits (58.1%), dyslipidemia (50.9%) and diabetes (40.1%). Coronary artery disease was present in 26.2% and cerebrovascular disease in 25.8%. Demographic data and previous medical history are described in Table 1.

Main results

Preoperative medical therapy

Only 58.8% of our cohort was under BMT upon admission. The BMT rate varied according to the admission diagnosis. Patients with intermittent claudication had the highest rate of adequate treatment use with 75% of patients under BMT. All other subgroups had similar rates, between 55 and 60% (Fig. 1).

Effective control of risk factors according to guideline targets

Regardless of the subgroup, only 65.4% of patients were on statin therapy and of these, only 37% had LDL-C values within the targets set by the guidelines for very high-risk patients.[8] In the remaining 34.6% of the patients that were not on statins, high LDL levels, ≥ 70 mg/dL, were observed in 71.4%.

In the group of patients with diabetes, only 34.6% of the 78 patients had HbA1c within the normal range. Additionally, in the remaining patients, 8.5% showed HbA1c values ≥ 7 mg/dL meaning patients were unaware of their diabetic condition.

Postoperative medical therapy and impact of Vascular Surgery admission

After discharge, the number of patients under BMT increased from 58.8% to 73.8% (95% CI, 2.2 – 7.8; $p < 0.001$), mostly attributed to the carotid disease group where this improvement was 25.6% (from 56.8% at baseline to 82.4% after intervention; 95% CI, 2.6 – 92.4; $p = 0.001$). There was also a significant improvement in the CLTI group, from 55.8% to 71.3% (95% CI, 2.1 – 23.8; $p = 0.002$). In the IC group, the difference between the pre and postoperative BMT was not statistically significant (75% *vs* 87.5% 95% CI, 0.2 – 157.5; $p = 0.317$) neither was the AAA group (63.3% *vs* 65% (95% CI, 0.4 – 3.7; $p = 0.796$) (Fig. 1; Table 2).

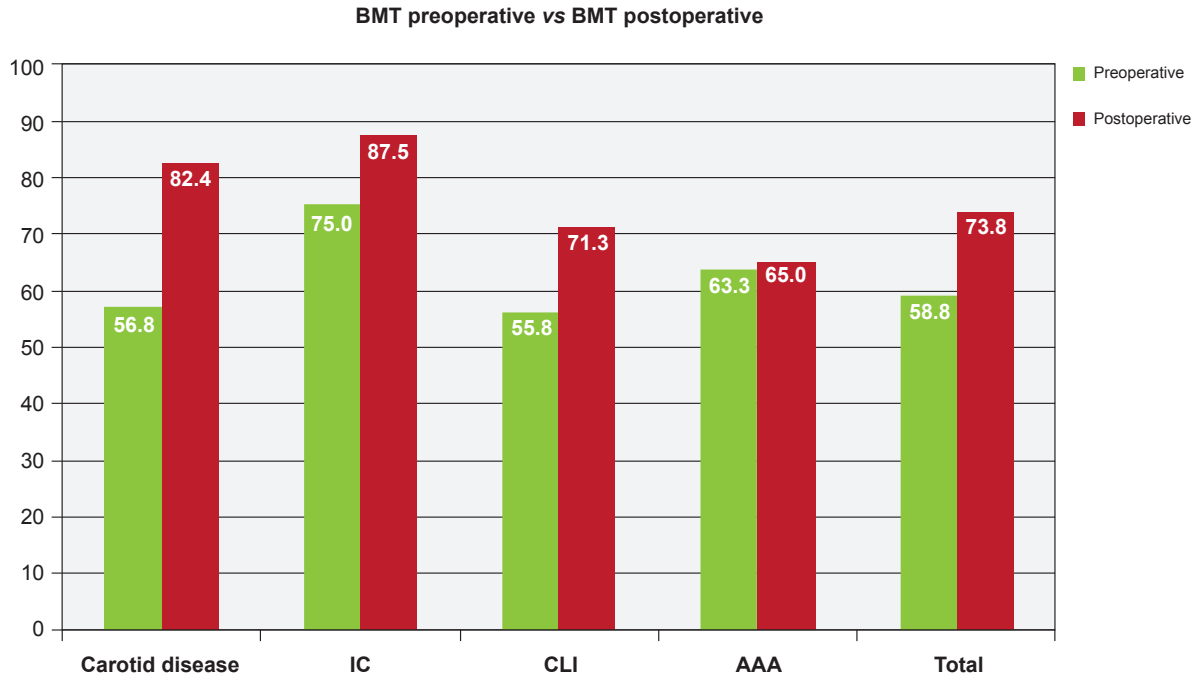

Figure 1 – Treatment demographics with percentage of patients on optimal medical therapy across procedures on admission and upon discharge (n = 291)
IC: intermittent claudication; CLI: critical limb ischemia; AAA: abdominal aortic aneurysm

Table 2 – Variation in best medical treatment's rate on admission and upon discharge across procedures

	BMT				
	Preoperative, %	**Postoperative**, %	**OR**	**95% CI**	***p*-value**
Carotid disease	42 (56.8)	61 (82.4)	10.5	2.5 – 93.4	0.001
Intermittent claudication	12 (75.0)	14 (87.5)	3.0	0.25 – 157.5	0.317
Critical limb ischemia	72 (55.8)	92 (71.3)	6.0	2.1 – 23.8	0.002
Aortic aneurysm	38 (63.3)	39 (65.0)	1.1	0.36 – 3.7	0.796

Nevertheless, IC remained the best-medicated subgroup, with 87.5% of patients under BMT postoperatively.

Other analyses

Preoperative medical therapy

When analyzing the prevalence of BMT based on risk factors and associated disorders, coronary artery disease ($p = 0.025$), previous coronary revascularization ($p = 0.001$), dyslipidemia ($p < 0.001$) and chronic kidney disease ($p = 0.043$) showed a positive association (Table 3) with better treatment.

In a multivariable logistic regression model, previous coronary revascularization, dyslipidemia, chronic kidney disease and cerebrovascular disease were significantly associated with BMT upon admission (Table 4).

MACE and mortality

During this study, 16 patients (5.8%) suffered major adverse cardiovascular events as defined previously. All cause in-hospital mortality was 3.2%, but only 1.1% (three patients) was attributed to MACE. CKD was the only comorbidity that was significantly associated with mortality ($p = 0.005$).

Although there was no statistically significant difference between MACE or mortality rates and preoperative BMT (MACE under BMT 46.6% *vs* MACE without BMT 53.3%, $p = 0.790$ / mortality under BMT 44.4% *versus* mortality without BMT 55.6%, $p = 0.050$, respectively), there was a clear trend towards an association.

DISCUSSION

Atherosclerosis is a polyvascular condition underlying most vascular surgery patients, from peripheral arterial disease to aortic aneurysms.[1] Despite advances in perioperative care, clinically significant cardiovascular complications remain frequent and result in an exceedingly high mortality rate, mainly from stroke and myocardial infarction.[2-7] Consequently, the European Society of Vascular Surgery (ESVS) and the European Society of Cardiology (ESC) guidelines support aggressive risk reduction therapies for secondary prevention in patients with atherosclerotic disease including PAD, aortic aneurysms and carotid artery disease. Those guidelines recommend pharmacological treatment with anti-thrombotic and lipid-lowering agents as well as antihypertensive and anti-diabetic drugs, when appropriate. Blood pressure should be < 140/90 mmHg (in patients with diabetes, diastolic BP should be < 85 mmHg), LDL-C < 70 mg/dl and HbA1c < 7%. Non-pharmacological therapies with

Table 3 – Univariate analysis of baseline characteristics potentially associated with BMT upon admission

	Preoperative BMT		
	Yes, %	**No**, %	***p*-value**
Male	126 (58.1)	91 (41.9)	0.649
Smoking history	90 (55.5)	72 (44.5)	0.198
Arterial hypertension	135 (60.3)	89 (39.7)	0.309
Dyslipidemia	99 (69.7)	43 (30.3)	< 0.001
Diabetes	68 (60.7)	44 (39.3)	0.591
Coronary artery disease	51 (69.9)	22 (30.1)	0.025
Coronary revascularization	40 (78.4)	11 (21.6)	0.001
Cerebrovascular disease	37 (51.4)	35 (48.6)	0.139
Chronic kidney disease	30 (73.2)	11 (26.8)	0.043
COPD	14 (51.9)	13 (48.1)	0.441
Cancer	13 (56.5)	10 (43.5)	0.818

COPD: chronic obstructive pulmonary disease

Table 4 – Multivariable logistic analysis of factors potentially associated with BMT upon admission

	95% CI	***p*-value**
Hypertension	-81 – 0.53	0.685
Diabetes	-0.49 – 0.61	0.827
Dislypidemia	0.50 – 1.56	< 0.001
Smoking history	-0.98 – 0.15	0.151
Coronary artery disease	-1.30 – 0.61	0.475
Coronary revascularization	0.19 – 2.46	0.023
Cerebrovascular disease	-1.27 – (-0.49)	0.034
Chonic kidney disease	0.01 – 1.63	0.049
Cancer	-0.78 – 1.04	0.776
Age	-1.63 – 1.65	0.641

lifestyle modifications such as smoking cessation, weight reduction and improvement of physical activity are equally important.[2,3,5,8,10]

The RCT's by Durazzo[16] and Schouten[17] also confirmed that peri-operative statin therapy reduced adverse cardiovascular events after AAA surgery.

Evidence from the UK Heart Protection Study revealed a 25% relative risk reduction in MACE with statin therapy in a subset of patients with PAD.[18] Randomized control trials on the effect of antithrombotic drugs in PAD patients, such as CAPRIE and more recently COMPASS and VOYAGER, identified a reduction of adverse effects, such as stroke and cardiovascular mortality, especially in high-risk groups.[19-21] De Martino further suggested, in a cohort-study of 14 489 patients, that anti-platelet and statin therapy was associated with reduced 30-day mortality and a 18% absolute improvement in 5-year survival after vascular surgery.[6]

Regarding carotid artery disease, observational studies showed that BMT was an effective strategy to reduce the stroke risk in patients with asymptomatic carotid stenosis.[13,14, 22]

However, despite the well-known benefits, the present study highlights a gap between the recommendations and 'real-world' practice. Upon admission to our department, only 58.8% of patients were on BMT. These findings are in line with those of previous randomized controlled trials like the bypass *versus* angioplasty in severe ischemia of the leg (BASIL) where only 54% of patients were on ATD and 34% on statins and the AAA OVER trial where there was also a low rate of patients on ATD.[23,24]

Moreover, we observed that patients with intermittent claudication were, upon admission, better treated compared to the other groups. This was already recognized in the literature[6] and may be due to higher awareness of t family doctors regarding the importance of good control of cardiovascular risk factors in avoiding cardiac and cerebral events.

In patients with carotid stenosis best medical treatment alone is associated with a reduced risk of stroke and may spare some interventions.[13,14] This contemporary concept emerged from population based studies where a strict risk factor control was achieved.[13,14] The importance of medical treatment was also recognized in randomized controlled trials like the revascularization *versus* Stenting trial (CREST) or the asymptomatic carotid surgery trial (ACST-1) where 85% – 90% were under BMT.[25-27] Notwithstanding, it remains questionable how these results from very controlled populations can be extrapolated to the real-world setting and some publications suggest that a significant number of patients remain under-treated.[6]

The analysis according to the risk factors, showed that coronary patients were under more comprehensive anti-atherosclerotic treatment than what was expected due to the surveillance protocols after events and intervention. Additionally, doctors seem to be aware of the impact of treating dyslipidemia and most patients are in fact under proper treatment and finally, CKD patients are usually under close surveillance with positive implications on BMT.

One of the strengths of our study was the assessment, not only of the pattern of anti-atherosclerosis medicines, but also of its effectiveness, considering the therapeutic targets suggested by the guidelines.

In our cohort, only about a third of patients on lipid lowering medication had LDL-C within the target values. Similarly, in the group of patients with diabetes, approximately a third of patients had HBA1c < 7 mg/dL. Additionally, 8.5% of the remaining patients had undiagnosed diabetes. This means that the number of patients that are not effectively controlled is much higher than just the ones that were not on BMT upon admission (41.2%).

Although the main goal of our study was to assess the pharmacological patterns and its real effectiveness, we also analyzed the impact of hospitalization on the improvement of medical treatment for atherosclerosis. Overall, the rate of patients on BMT increased by 15% (from 58.8% to nearly 75%). Despite the positive association, this moderate increase emphasizes the missed opportunities to improve medical therapy after admission in a Vascular Surgery ward.

A comment should also be added regarding the lack of impact of the BMT on MACE. A positive association is, however, well established in the literature and our results are influenced by the sample size. Nevertheless, mortality was higher in patients without BMT and this trend almost reached significance ($p = 0.05$).

Our study has some limitations. The sample used is relatively small, the dosage of each drug wasn't always recorded, and previous hypertension was documented but the ambulatory blood pressure measurements were not consistently reported. The effective control of arterial hypertension was not included as it seemed difficult to assess the ambulatory control based on measurements during hospital admissions for surgical procedures or for critical conditions. We also acknowledge that, if some of the major benefits of BMT were likely to be obtained in the long term, follow-up data and information regarding adherence to treatment should be included in a subsequent prospective study. Despite these limitations, our results highlight the gap between the 'real world' setting and the guideline recommendations and offer an opportunity to rethink the way we manage our patients.

As atherosclerosis is increasingly viewed of as a systemic disease, it may be advisable in the future to devise a multidisciplinary approach to improve the treatment of these patients. Improving overall awareness of the need for cardiovascular risk factor control and adequate anti-atherosclerotic medication in the primary care setting, and a specialized consultation and dedicated outpatient clinic for risk factor control would probably be beneficial in order to improve our results.

Future studies are needed in order to address some key questions. A follow-up study, with mid to long-term data, would be necessary in order to analyze a continued benefit of our interventions and to draw further conclusions regarding long-term risk factor control, adherence to treatment

protocols and long-term results regarding MACE. Furthermore, comparative studies with other non-vascular surgery patients, would also be useful in order to understand if this is general problem or a specific issue regarding vascular surgery patients.

CONCLUSION

Despite the current recommendations, the rate of patients on BMT only increased by 15% (from 58.8% to nearly 75%) after admission in a Vascular Surgery Department. Although this suboptimal treatment did not show significant differences in MACE or mortality, we strongly believe that the admission to a vascular surgery ward should be an opportunity to optimize medical treatment in order to improve outcomes and the cardiovascular risk profiles. Therefore, these results are an opportunity to alert physicians to this problem and to find future multidisciplinary solutions that can improve the treatment of these patients.

AUTHORS CONTRIBUTION:

AL: Responsible for conception and design of the study. Collected, analyzed and interpreted the patient data. read and approved the final manuscript.

LMP: Responsible for conception and design of the study. Read and approved the final manuscript.

RM, LMP: Major contributors in writing the manuscript. Read and approved the final manuscript.

PROTECTION OF HUMANS AND ANIMALS

The authors declare that the procedures were followed according to the regulations established by the Clinical Research and Ethics Committee and to the Helsinki Declaration of the World Medical Association updated in 2013.

DATA CONFIDENTIALITY

The authors declare having followed the protocols in use at their working center regarding patients' data publication.

COMPETING INTERESTS

The authors declare that there is no conflict of interests regarding the publication of this paper.

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