



DISSERTAÇÃO DE MESTRADO EM EPIDEMIOLOGIA

**Comparison of endovascular stenting with bypass grafting results for
TransAtlantic Inter-Society Consensus (TASC II) type D aorto-iliac occlusive
disease, 2011-2017**

Apresentada sob a orientação da

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2018

Título: *Comparison of endovascular stenting with bypass grafting results for TransAtlantic Inter-Society Consensus (TASC II) type D aorto-iliac occlusive disease, 2011-2017*

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Edição: do autor

Ano: 2018

Investigação realizada no Serviço de Angiologia e Cirurgia Vascular do Centro Hospitalar de São João, E.P.E., sob a orientação da Professora Doutora Ana Azevedo Cardoso de Oliveira.

AKNOWLEDGEMENTS

Os meus agradecimentos,

à Professora Ana Azevedo Cardoso de Oliveira, pela disponibilidade em se aventurar na orientação deste projeto e pela aprendizagem que me concedeu.

aos colegas que conheci e com quem tive o privilégio de percorrer mais este caminho;

aos meus pais.

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LIST OF ABBREVIATIONS

AIOC – Aortoiliac occlusive disease

ABF – Aortobifemoral bypass

CIA - Common iliac arteries

EIA – external iliac artery

EQ-5D-5L – EuroQol group – 5 dimensions – 5 level questionnaire®

PCIS – Percutaneous iliac stenting

QoL – Quality of life

TASC D – TransAtlantic Inter-Society Consensus II (TASC II), iliac type D lesions

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OBJECTIVES

The management of the patient with peripheral arterial disease (PAD) has to be planned in the context of the natural history of the disease and considering, in particular, patient's quality of life. The growing awareness and demand from the patients led to increased resource consumption. The cost benefit and resource consumption associated to the procedures is also to be accounted, maintaining or achieving better results, mainly shortening inpatient times and increasing treatment availability.

This study analyses the outcomes of iliac stenting in TASC type D aortoiliac disease and compares its technical and short-term success to those of ABF grafting. The post-operative health-related quality of life (QoL) and walking ability in a sample of patients from two Portuguese hospitals (Centro Hospitalar de São João – CHSJ, and Centro Hospitalar do Tâmega e Sousa - CHTS) were acquired. Resorting to specialized software HVITAL the economic burden of both procedures in CHSJ was evaluated.

ABSTRACT PORTUGUESE

Introdução: O tratamento da doença aorto-iliaca oclusiva é uma das discussões mais significantes da cirurgia vascular. Nos últimos anos a abordagem endovascular tem demonstrado resultados promissores, contudo a cirurgia aberta mantém-se como o padrão de tratamento em lesões complexas. O objetivo deste estudo foi comparar os resultados técnicos, clínicos e económicos destas abordagens em doentes com padrão de doença TASC D no setor ilíaco.

Métodos: Foram seleccionados todos os doentes com padrão de doença TASC D no setor ilíaco submetidos a cirurgia de revascularização, aberta ou endovascular, de duas instituições portuguesas entre Janeiro de 2011 e Outubro de 2017. A seleção da abordagem foi deixada ao cirurgião.

Resultados: O bypass aortobifemoral foi realizado como opção primária em 27 doentes, e a abordagem endovascular foi tentada em 32 doentes. Os doentes submetidos a procedimentos endovasculares tinham maior probabilidade de apresentar insuficiência cardíaca ($P=0.001$) e história de tabagismo ($P=0.030$). O período médio de seguimento foi 56 ± 3.5 meses. A cirurgia aberta apresentou maior sucesso técnico ($P=0.001$); contudo, as taxas de salvamento de membro e de patência foram diferentes entre os grupos. A abordagem endovascular demonstrou associação com tempos de internamento mais curso, quer em enfermaria (6 vs 9 dias; $P=0.041$), em unidade de cuidados intensivos (0 vs 3.81 days; $P=0.001$) e com um custo por procedimento similar (μ : 2080 vs 1053€; $P=0.6$). Não foram detetadas diferenças na qualidade de vida pós-operatória.

Conclusão: A abordagem endovascular primária é pelo menos equivalente do ponto de vista clínico à cirurgia de bypass aortobifemoral, apresentando melhores resultados

económicos. A abordagem endovascular primária pode ser uma opção válida nos doentes com TASC D do setor ilíaco.

ABSTRACT EN

Introduction: One of the most significant current discussions in peripheral artery disease is the treatment of aortoiliac occlusive disease (AIOD). In the last few years, endovascular approaches have shown promising results, however open surgery remains the standard for more complex lesions. The aim of this study was to compare technical, clinical and economic outcomes between both approaches in aortoiliac TASC D patients.

Methods: Patients undergoing revascularization for TASC D lesions, either endovascular or open surgery, from two Portuguese institutions between January 2011 and October 2017 were included. The surgical technique was left to the surgeon discretion.

Results: Twenty-seven patients underwent aortobifemoral bypass and thirty-two patients were submitted to endovascular repair. The patients undergoing endovascular procedure were more likely to present chronic heart failure ($P=0.001$) and less smoking habits ($P=0.03$). The mean follow-up period was 56 ± 3.5 months. The open surgery presented a higher technical success ($P=0.001$); however, limb salvage and patency rates were not different between groups. Endovascular approach was associated with a shorter length of stay, both in ward (6 vs 9 days; $P=0.041$) and in ICU unit (0 vs 3.81 days; $P=0.001$) and lower hospital expenses (8337€ vs 20.694,5€; $P=0.001$) with a similar procedure cost (μ : 2080 vs 1053€; $P=0.6$). No differences were found in post-surgical quality-of-life.

Conclusion: Endovascular approach is, at least, clinically equivalent to open surgery and has superior economic outcome. The “endovascular-first” approach can be a valid option for TASC type D lesions.

INTRODUCTION

Revascularization is the method of choice for treating lifestyle limiting intermittent claudication or critical ischemia in patients with aortoiliac occlusive disease (AIOD). According to the TransAtlantic Inter-Society Consensus II (TASC II), type D lesions (TASC D) include infra-renal aortoiliac occlusions (AIOC), unilateral occlusions of common (CIA) and external iliac arteries (EIA) and bilateral occlusions of EIA (Figure 1) (1). The treatment of these complex AIOC has been matter of debate over the last years. The most recent European Society of Cardiology guidelines for treatment of peripheral artery disease recommend an endovascular-first approach for AIOD in case of short occlusive lesions, long and/or bilateral lesions in patients with several comorbidities and when performed by an experienced team, if not precluding subsequent surgical options (2). Open surgery remains the method of choice for young patients, fit for surgery, with AIOC (2). However, aortobifemoral (ABF) grafting is associated with a 3 to 5% risk of operative mortality (3), an important perioperative morbidity and a delay in the return to normal routine (4-6).

In the last few years, device development to overcome total occlusions and increasing expertise levels among vascular surgeons led to a more frequent utilization of endovascular approaches for AIOC (7, 8). Moreover, endovascular approaches have demonstrated remarkable results on the treatment of aortoiliac TASC type D lesions, despite a lesser primary patency (4, 6, 9, 10), with experienced centers and the most recent guidelines proposing an “endovascular-first” approach (2, 8). This recommendation is based on the assumption that an unsuccessful endovascular attempt does not preclude subsequent ABF grafting (5, 11). Debate about the best strategies for

the management of TASC type D lesions continues, and further evidence for the best treatment in this group of patients is still needed.

This study analyses the outcomes of iliac stenting in TASC type D aortoiliac disease and compares its technical and short-term success to those of ABF grafting. The post-operative health-related quality of life (QoL) and walking ability in a sample of patients from two Portuguese hospitals, as well as the economic burden of both procedures, were evaluated.

METHODS

Patient selection and data collection

All patients with TASC D aorto-iliac lesions submitted either to endovascular or aorto-bifemoral bypass between January 2011 and October 2017 in two hospitals from metropolitan region of Porto were retrospectively assessed (Centro Hospitalar de São João – tertiary center - and Hospital Padre Américo – primary hospital). Patients with common femoral artery obstructive disease or aortoiliac aneurismatic disease, were excluded. The study protocol was approved by the local Ethics Committee and is according to Helsinki declaration.

Patient demographics, cardiovascular risk factors, clinical presentation, procedural and lesion-specific details, outcomes and complications were retrospectively obtained from detailed revision of the patient's clinical records. Original arteriogram and angio-CT images were retrieved and reviewed by three independent and experienced Vascular surgeons (J.R.N., J.S. and J.V.).

All data regarding patients and procedure were defined according to the Society for Vascular Surgery reporting standard for lower extremity ischemia (12). Symptoms of chronic lower extremity ischemia were classified according to Rutherford(13). Outcome data including peri-procedural complications, ankle-brachial index (ABI) evolution, morbidity, and mortality were collected.

Interventions

Surgical decision between these 2 procedures was not randomly assigned and was performed according to operator discretion. In the endovascular group, if

recanalization was not successful, the ABF procedure was an option in patients who presented technically failed percutaneous intervention. Technical success was defined as patency at 30 days post-procedure (14). Both groups were analyzed regarding the initial approach decision. The failed revascularizations group was separately analyzed.

All endovascular procedures were performed by a vascular surgeon, either in an angiography suite or in a C-arm equipped operative room. Under local anesthesia, an ipsilateral or a contralateral approach with a 6-French introducer was used depending on the clinical situation.

Balloon-expandable (BE) stents were preferentially used for more severely calcified lesions as well as lesions in the aortic bifurcation. Self-expandable stents were usually implanted when the distal EIA was affected. No covered stents were used in this study. The length of lesions was categorized according to the criteria of the TASC II document(2). After stent implantation, aspirin (100 mg/day) and clopidogrel (75 mg/day) were prescribed for 3 months. After 3 months, aspirin (100 mg/day) was recommended for long term use.

Direct aortoiliac bypass operations were performed in an operating room under general anesthesia via a transperitoneal approach and unilateral bypass procedures via a retroperitoneal approach under epidural anesthesia. Double woven graft was used for all the bilateral aortoiliac surgical reconstructions. After synthetic vascular graft implantation, aspirin (100 mg per day) or clopidogrel (75 mg per day) were prescribed lifelong.

Postoperative surveillance

Post-operative surveillance of revascularizations consisted of clinical evaluation, Doppler ultrasound and noninvasive Doppler arterial study with ABI measurements, and was generally performed at 1, 6 and 12 months, followed by biannual or annual follow-up. Primary patency was defined as patency during the interval between primary intervention and repeated radiologic intervention whether to thrombosis, in-stent restenosis or any other procedure necessary to maintain permeability. Assisted primary patency was defined as patency during the interval between primary intervention and the time when the angioplasty/bypass occluded, independently of the number of re-interventions necessary to maintain permeability. Secondary patency is the patency obtained with the use of an additional or secondary surgical or endovascular procedure after occlusion occurs (14). Loss of primary patency was defined as stenosis >50% in doppler ultrassound or a >0.14 decrease in the ABI or stent / bypass thrombosis. In these cases, patients underwent either computed tomography angiography or conventional digital subtraction arteriography. The indications for secondary intervention included clinical symptoms associated with loss of primary patency.

Endpoints

Primary endpoint was primary, assisted primary or secondary patency. Secondary endpoints were limb salvage, prosthesis infection, mortality, QoL and disease specific Qol impairment and procedure costs.

Two Portuguese-language validated questionnaires were cross-sectionally (November 2017) applied to the sample: a disease-specific questionnaire - the walking

impairment questionnaire -, and a generic quality of life (QoL) questionnaire - the EQ-5D-5L[®] (15, 16). On a total of 47 patients that were alive, 36 answered the questionnaire, of the remaining 11 patients, 8 were not possible to establish contact and 3 did not have the necessary cognitive function. The patients were personally interviewed after a brief form explanation (A.F).

The Centro Hospitalar São João, EPE. exact resource (equipment and disposable material) consumption cost was assessed using HVITAL Software and extracted by the data manager (S.M.V.) (17). This analysis was not possible in Centro Hospitalar do Tamega e Sousa. The cost of the length-of-stay was calculated based on the institutional data provided. Per day, the inpatient cost in a standard ward is 537 € whereas in ICU is 2940€. The total cost of an intervention was calculated by the formula: procedure cost plus length-of-stay (procedure cost + mean ward days x 537€ + UCI days x 2940).

In first instance, both surgical groups were compared regarding the baseline characteristics. Patients submitted to endovascular approach and patients with technical success were compared regarding baseline characteristics. A baseline comparison between patients technically succeeded and those not succeeded was also made.

Statistical Analysis

Statistics were performed with SPSS 24.0. Baseline characteristics were compared using Chi-Square, Student t-test and Mann-Whitney categorical variables analysed by chi-square; continuous variables with normal distribution by t-test and skewed with Mann-Whitney.. Outcome variables were evaluated by log rank test and Cox regression for the dependent time variables. The mean follow-up times were

calculated by the reverse Kaplan-Meier method. The threshold for significance was set at 5%.

Variables with clinical relevance included in multivariate analysis were those associated with primary patency loss in univariate analysis.

RESULTS

Study sample

This study included 59 patients, 32 (54%) in the endovascular groups and 27 (46%) in the open surgery group. In the overall study population, patients selected for an endovascular procedure had a mean age of 65.6 ± 12.2 years while those undergoing ABF had a mean age of 62.1 ± 6.5 years ($P=0.173$). Detailed data on demographics are described in table I. Chronic heart failure (CHF) was present only in the endovascular group (31.3% vs 0; $P=0.03$). A trend for smoking habits (ABF - 100% vs Endovascular - 75%; $p=0.05$) and chronic kidney disease (7.4% vs 25%; $P=0.073$) was present.

Surgical outcomes

The median follow-up for all patients was 56 ± 3.5 months and did not significantly differ between groups (mean: endovascular approach 48 ± 5.3 ; ABF 65.5 ± 3.9 , $P=0.689$).

Technical success was significantly higher in the open surgery group (100% vs 65.6%, $P=0.001$). Baseline comparison between groups revealed that lighter smoking habits (100% vs 75%, $P=0.005$) and CHF (0 vs 31.3%, $P=0.001$) at presentation were significantly more prevalent in the endovascular approach (Table 1). The group with endovascular technical success differed similarly from the ABF group although demonstrating additionally significance for chronic kidney disease (CKD -

creatinine > 1.5 mg/dl), (7.4% vs 33.3%, $P=0.022$), and critical limb ischemia (44.4% vs 76.2%, $P=0.027$) at presentation.

Eleven endovascular procedures were not technically successful and, subsequently, patients were submitted to ABF ($n=6$), axillobifemoral bypass ($n=1$), iliac stent with femorofemoral bypass ($n=1$) and best medical treatment ($n=3$). The mean Rutherford level at presentation was 3.3 and four patients had critical limb ischemia. The mean follow-up of these patients was 58 ± 3.5 months.

The groups did not differ regarding limb salvage, infra-inguinal revascularization, first-month post-surgery ABI and long-term mortality (table 2). At 12 months no differences were found in artery primary, assisted primary and secondary patency between approaches. The patency of procedures remained similar after adjusting for smoking habits (HR: 1.08 [0.206-5.47] $P=0.925$) and CHF (HR: 2.91 [0.714-11.82], $P=0.137$). Although marginally significant, only ABF procedures were complicated by infection (11.1% vs 0%; $P=0.053$).

Procedure Costs

The mean direct costs in disposable material and equipment of the endovascular approach was significantly higher than that of the open surgery (1053 ± 701 € vs 1742 ± 1386 ; $P=0.001$). However, patients undergoing the ABF procedure present a longer length-of-stay, spending significantly more time both in ward (9 vs 6 days; $P=0.041$) and in the ICU (3.81 vs 0 days; $P=0.001$). Therefore, the total cost of a patient, including procedure and admission, is significantly higher with open surgery (20.694 ± 22346 € vs 10533 ± 12737 €, $P=0.001$) (Table 2). The differences between groups

regarding the length of stay remained significant after splitting the analysis for the Rutherford subgroups: claudication and critical ischemia.

Failed endovascular procedures had an equipment and material mean cost of 1.193€ and a total mean cost of 12.192€. Therefore, taking in account all endovascular procedures, the technical failures imposed an increment of only 580€ to each successful intervention.

Regarding re-intervention the angioplasty was the method of choice for the initial endovascular approach group and 5 (71%) of ABF patients. There were no differences regarding length-of-stay or costs of the second procedure (table 2).

Quality of life Assessment

After cross-sectionally applying the questionnaires, the endovascular approach group demonstrated a trend towards a higher global WIQ pain score ($p=0.052$) and statistically significant differences were found only in the question B3 (increased degree of difficulty walking 150 meters in the endovascular approach group) ($p<0,001$). The remaining domains (walking speed and climbing stairs) did not differ for global scores or individual questions (Table 3, Figure 4). The score in EQ-5D-5L questionnaire was not statistically different between groups individually or the index score (Table 3, Picture 5).

DISCUSSION

The TASC type D AIOD standard of care remains controversial (1, 2). However, the morbidity (4, 5) and mortality (3) rates of open procedure are shifting the attention towards an “endovascular-first” approach even in complex lesions (8). In the present study, the technical and clinical success of the initial endovascular approach or open repair by means of ABF for TASC type D bilateral AIOD were compared. No significant differences were found regarding long-term patency despite a higher technical success of open surgery.

The one-year patency, both crude and adjusted for smoking history, CHF and critical ischemia, did not differ between groups. These values fall below those reported by Kashyap et al (18) using patients with TASC type B or higher and those reviewed for TASC types C and D occlusive lesions (6). However, the rates here reported for ABF group were acceptable since only patients with TASC type D were included. The secondary patency rates were similar to the ones reported in the literature (6, 18).

For percutaneous iliac stenting (PCIS), the primary patency for TASC D lesions in the literature varies between 70% to 97% at 12mo and 70.9% to 93% at 24mo (6, 9, 10, 19-21). In the present study, although a different analysis was performed the primary patency at 12mo and 18mo was 82.2% and 69.1%, respectively. In this series, three factors (Smoking, CHF and CKD) were more prevalent in those who underwent an endovascular procedure technically succeeded when compared with those submitted to open surgery. These three factors are also related with loss of primary patency (4) which might contribute for the lower primary patency at 18 months. However, the cox-regression analysis for CHF and critical ischemia did not demonstrate significant effects. The ABF group also presented values of patency below those reported in

literature which demonstrates that this series dealt with more severe and complex lesions as only TASC type D were included. In the present study, the secondary patency for the endovascular approach was 100% at 12 months which converges with previous reports (9, 10, 19, 20). These findings emphasize the paradigm shift towards an “endovascular-first” approach. Supporting this view is the fact that an open surgery can still be performed when the endovascular approach is not succeeded, seemingly without an increased risk of poor outcomes (11). In fact, it was reported an improved survival and a similar limb salvage rate for ABF after a failed endovascular attempt when compared with primary ABF procedure (11).

Additionally, patients submitted to the endovascular approach were less frequently smokers, as verified in other studies (5, 18), and presented a significantly higher prevalence of CKD, CHF and critical ischemia at presentation, in the subgroup with technical success. Therefore, these patients were more fragile and prone to worse outcomes, severe lesions at presentation, major adverse limb events (4) and lower survival (18). The latter two variables reflect the atherosclerotic burden and were significantly impaired by the CHF, only present in the PCIS group due to a selection bias. Dyslipidemia and diabetes mellitus were not different in this series. The group submitted to ABF procedure had a mean age of 62 years, which favors the long-term patency; it was observed that patients <50 years old have less 30% of 5-year PP rate and less than 20% of 5-year SP rate when compared with patients >60 years old (22). This difference might reflect a more aggressive and progressive atherosclerotic process conditioning worse outcomes.

All ABF procedures were succeeded whereas only endovascular approach had a 65.6% of technical success. The outcomes of endovascular treatment for extensive AIOD were previously addressed in a systematic review and technical success rates

were reported to be achieved in 86% to 100% of the patients (9). However, the review included both TASC type C and D lesions. For TASC type D lesions, the technical success is lower, ranging from 76.6% to 96.2%, with a mean of 90.1% (10). The lower technical success here presented might be explained by technical limitations, as most of the failures were early tries (8 out of 11 technical failures were before 2014).

Concerning the surgery outcomes, the groups did not differ regarding limb salvage, infra-inguinal revascularization, post-surgery ABI and mortality. Of note, femoro-distal occlusive disease concomitant with iliac occlusion is a predictor for loss of PP in both procedures (5, 18, 23). The long-term mortality was not different between the techniques, in accordance with other reports (18 months - ABF: 81.9% SE=8.3% vs PCIS: 82% SE=7.3%) (4, 18, 24).

Regarding the patient-reported QoL, this study demonstrated only minor differences. Despite the significantly higher comorbidities in the PCIS group, the EQ-5D-5L questionnaire did not find any differences between groups. Comparing the disease-specific questionnaire, only minor significant changes were found in the claudication distance. This finding is compatible with the similar ABI that the patients presented in the first post-operative month.

The mean direct cost of the endovascular approach is significantly higher than that of a conventional approach. In fact, an iliac stent costs three times more than an ABF graft (24). However, patients undergoing the ABF procedure presented significantly longer in-hospital time, in agreement with other reports (4, 5, 24-26), both in ward and ICU, being the later six-times more expensive. Therefore, the total costs of a patient, including procedure and admission, were significantly higher with open surgery. When the cost analysis was stratified according to the clinical peripheral artery disease staging (claudicants vs critical ischemia) the cost benefit remained present in

both categories. Moreover, endovascular technical failures only increased the total mean costs of each successful endovascular procedure in 580€. Since this study has low re-intervention rates it was not possible to provide a reliable analysis of cost of re-intervention. The few data available demonstrated similar costs, which were credible since the re-intervention strategy is the same (71% vs 100%, $p=0.417$).

Despite the fact that previous studies found no difference between the costs of , of both procedures (25), recently endovascular approach was found to be less costly than the open procedure (24, 26). This shift of direction in the cost difference associated with the lower morbidity, mortality and length of stay of the endovascular technique has important implication as cost-containment policies are an ever-increasing theme of debate in healthcare policies. The indirect costs implied by prosthesis infection were not estimated although it would further increase the ABF procedure-related costs.

This study has several limitations. First limitation was the lack of randomization for endovascular vs. open surgery selection, as the criteria was left to the surgeon's discretion. Consequently, the endovascular group presented with a higher prevalence of comorbidities which could bias the QoL assessment and all the remaining endpoints. Another potential source of bias was the cross-sectional application of the QoL and disease-specific questionnaires, although the absence of significant differences in the follow-up period could mitigate the difference. Post-operative DALYs or the time needed to achieve peak post-operative QoIL was not measured, although the ward and ICU days are a good post-operative morbidity indicator. Due to the severity of the lesions selected, this study presented a small sample although comparable with previous reports.

CONCLUSION

To our best knowledge, this is the first study comparing the economic burden of these two approaches simultaneously with the post-surgical patients' quality of life.

Despite the higher rates of technical success in the open surgery group, the short-term patency and limb salvage of these procedures seem to be similar, as well as the post-operative patient referred Qol. Besides, the endovascular approach of the aortoiliac sector remains significantly less invasive imposing less perioperative morbidity, faster discharge, less disable days and less resource consumption. Moreover, execution of this procedure does not seem to negatively impact a future surgery, in case of technical failure, although more studies with longer follow-up are needed.

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Tables

Table 1 – Demographic and clinical data from patients undergoing revascularization for TASC D lesions.

| Variables | ABF (n=27) | Endovascular approach (n=32) | P value * | PCIS ^o (n=21) | pP value [†] |
|----------------------------------|------------|------------------------------|-----------|--------------------------|-----------------------|
| Age, years (mean ± SD) | 62.1 ± 6.5 | 65.6 ± 12.2 | 0.173 | 65.0 ± 12.4 | 0.338 |
| Sex (male) | 25 (92.6%) | 29 (90.6%) | 0.582 | 19 (90.5%) | 0.594 |
| HTN | 19 (70.4%) | 17 (75%) | 0.690 | 15 (71.4%) | 0.936 |
| Smoking | 27 (100%) | 27 (75%) | 0.050 | 15 (71.4%) | 0.030 |
| CKD | 2 (7.4%) | 8 (25%) | 0.073 | 7 (33.3%) | 0.022 |
| DM | 9 (33.6%) | 9 (33.3%) | 0.564 | 8 (38.1%) | 0.732 |
| Dyslipidemia | 17 (63%) | 24 (75%) | 0.317 | 15 (71.4%) | 0.537 |
| CAD | 6 (22.2%) | 12 (37.5%) | 0.204 | 7 (33.3%) | 0.380 |
| CHF | 0 | 10 (31.3%) | 0.001 | 6 (28.6%) | 0.030 |
| COPD | 4 (14.8%) | 5 (15.6%) | 0.931 | 3 (14.3%) | 0.959 |
| SFA disease | 18 (66.7%) | 22 (68.8%) | 0.865 | 14 (66.7%) | 1 |
| Critical ischemia | 12 (44.4%) | 21 (65.6%) | 0.103 | 16 (76.2%) | 0.027 |
| Rutherford Classification (mean) | 3.78 | 4.06 | 0.152 | 4.18 | 0.124 |

| | | | | | |
|-------------------|-----------|------------|-------|-----------|--|
| Claudication | | | | | |
| Rutherford 3 | 14(51.9%) | 11 (34.4%) | | 5 (23.8%) | |
| Critical ischemia | | | | | |
| Rutherford 4 | 5 (18.5%) | 11 (34.4%) | | 9 (42.9%) | |
| Rutherford 5 | 8 (29.6%) | 7 (21.9%) | | 5 (23.8%) | |
| Rutherford 6 | 0 | 3 (9.4%) | | 2 (9.5%) | |
| Technical success | 27 (100%) | 21 (65.6%) | 0.001 | | |

ABF – aortobifemoral bypass grafting; CAD – Coronary Artery Disease; CHF – Chronic Heart Failure; CKD – Chronic kidney disease (creat>1.5mg/dl); COPD - Chronic Obstructive Pulmonary Disease; DM – Diabetes mellitus; HTN – Hypertension; PCIS– Percutaneous iliac stenting; SD – standard deviation; SFA disease – superficial femoral artery hemodynamically significant atherosclerotic disease. TASC D – TransAtlantic Inter-Society Consensus II (TASC II), iliac type D lesions

° PCIS– Percutaneous iliac stenting – includes the patients from the endovascular approach group that were technically successful at first attempt.

*Aortobifemoral bypass vs Endovascular approach

†Aortobifemoral bypass vs Percutaneous Iliac stenting

Table 2 – Post-operative clinical factors, outcomes and costs of patients who underwent open surgery or endovascular approach* for iliac TASC D lesions.

| | ABF (n=27) | Endovascular Approach (n=32) | P value |
|---------------------------------|------------------|------------------------------|---------|
| Follow-up (mean months±SD) | 65.5± 3.9 | 48.2±5.1 | 0.689 |
| Infrainguinal Revascularization | 6 (22.2%) | 11 (34.4%) | 0.352 |
| Ankle Brachial Index (mean) | 0.79 ± 0.22 | 0.74 ± 0.23 | 0.383 |
| Primary patency | | | |
| 12 months | 85% (SE=6.9%) | 82.2% (SE=7.3%) | 0.584 |
| 24 months | 76.1% (SE=9%) | 69.1% (SE=9.3%) | |
| Assisted primary patency | | | |
| 12 months | 85% (SE=6.9%) | 83.6% (SE=7.5%) | 0.709 |
| Secondary patency | | | |
| 12 months | 92.3% (SE=5.2%) | 100% | 0.689 |
| Limb salvage | | | |
| 18 months | (91.7%) (SE=8%) | 93.3% (SE=6.4%) | 0.645 |
| Mortality | | | |
| 18 months | 81.9% (SE= 8.3%) | 82% (SE= 7.3%) | 0.367 |
| Infection | 3 (11.1%) | 0 | 0.053 |

| | | | |
|--|-----------------|---------------|-------|
| First procedure cost, € (mean (SD)) | | | |
| Claudicants | 910 ± 614 | 1398 ± 1019 | 0.245 |
| Critical ischemia | 1160 ± 767 | 1954 ± 1571 | 0.122 |
| Total | 1053 ± 701 | 1742 ± 1386 | 0.049 |
| Ward days (median - IQ) | | | |
| Claudicants | 6 [3-11] | 2 [0-8] | 0.62 |
| Critical ischemia | 21 [10-24.75] | 10 [0-20] | 0.048 |
| Total | 9 [4-24] | 5 [2-11] | 0.09 |
| ICU, days (median - IQ) | | | |
| Claudicants | 3 [2-4] | 0 [0-0] | 0.02 |
| Critical ischemia | 3 [2.25-4.75] | 0 [0-0] | 0.0 |
| Total | 3.81 [2-4] | 0 [0-0] | 0.0 |
| First intervention total costs, € (mean (SD)) [†] | 20694.5 ± 22346 | 10533 ± 12737 | 0.029 |
| Ward days in re-intervention (Median - IQ) | 9.5 [1-14.25] | 9 [1-14] | 0.543 |

| | | | |
|--|------------|-------------|-------|
| ICU days in re-intervention (Median - IQ) | 0[0-1] | 2 [0-4] | 0.151 |
| Re-intervention total costs, € (mean (SD)) [‡] | 12338±5846 | 13929±11775 | 0.841 |
| Endovascular re-intervention | 5 (71%) | 8 (100%) | 0.935 |

ICU – intensive care unit; IQ – interquartile range; SD – standard deviation;

*Endovascular approach includes patency after first failed revascularization and successful second attempt.

[‡] First intervention costs = First procedure cost + Length of stay (Mean ward days x 537€ + ICU days x 2940€)

[‡] Reintervention costs = Second procedure cost + Length of stay (Second intervention mean ward days x 537€ + Second intervention ICU days x 2940€)

Table 3 - Descriptive statistics of Peripheral Artery Disease and QoL questionnaires' scores

| | ABF | Endovascular approach | P-value* |
|------------------------------------|--------------|-----------------------|----------|
| WIQ Pain Score (0-24) | 20.50 ±2.53 | 17.64±5.74 | 0.068 |
| WIQ Walking distance Score (0-100) | 44.42 ±35.15 | 34.53±40.72 | 0.467 |
| WIQ Walking velocity Score (0-100) | 31.70 ±18.50 | 34.29±30.53 | 0.773 |
| WIQ Climbing stairs Score (0-100) | 68.75 ±30.91 | 60.71±33.56 | 0.487 |
| EQ-5D-5L B6 | 78% ±21.04 | 83%±12.5 | 0.889 |
| EQ-5D-5L Index [□] | 0,78 ±0.63 | 1.07±0.879 | 0.303 |

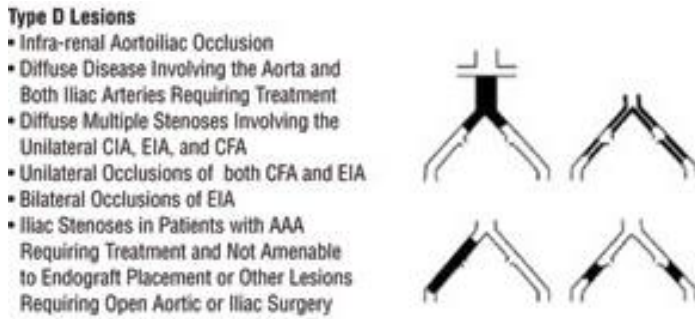
All data are mean±standard deviation

[□] using EQ-5D-5L[®] formula

WIQ – walking impairment questionnaire; EQ-5D-5L - 5-level EQ-5D version questionnaire

Figures

Figure 1 – TASC D atherosclerotic lesions selected for the present study



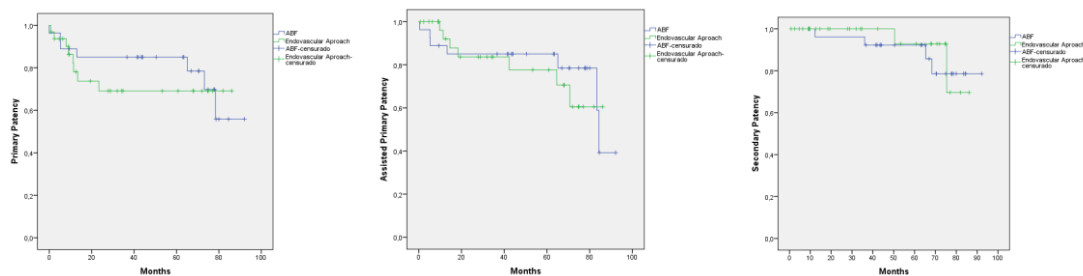
TASC D – TransAtlantic Inter-Society Consensus II (TASC II), iliac type D lesions

Figure 2 – Kaplan-Meier curve estimates for patency according to treatment groups.

Panel A: primary patency in patients undergoing aortobifemoral (ABF; blue line) bypass vs endovascular approach (green line). (logRank P=0.584).

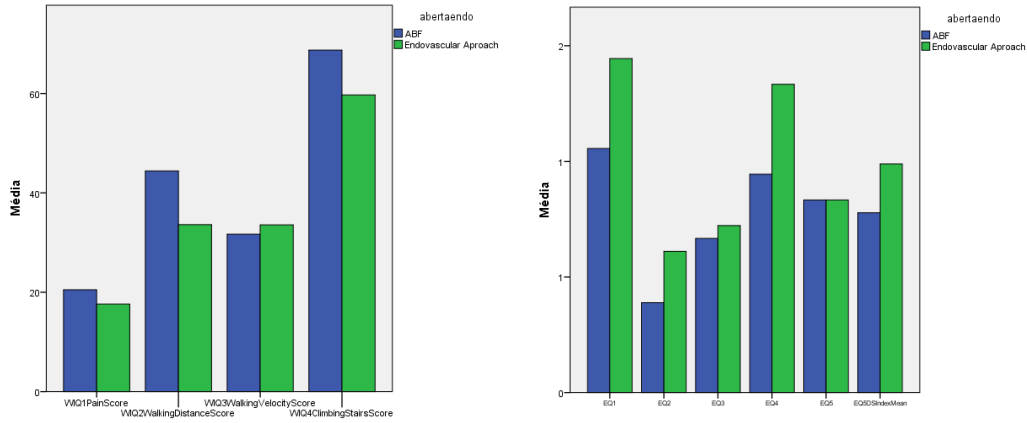
Panel B: assisted primary patency in patients undergoing aortobifemoral (ABF; blue line) bypass vs endovascular approach (green line). (logRank P=0.709).

Panel C: secondary patency in patients undergoing aortobifemoral (ABF; blue line) bypass vs endovascular approach (green line). (logRank P=0.689).



ABF – Aortobifemoral bypass graft; Endovascular approach (Stenting and secondary open reinterventions)

Figure 3 – Histogram of Walking Impairment Questionnaire and EQ-5D-5L questionnaire results.



WIQ – Walking Impairment Questionnaire; WIQ pain – Pain Score; WIQ Walking Velocity – Walking Velocity Score; WIQ Climbing Stairs – Climbing Stairs Score; EQ5D5L – Question 1, 2, 3, 4, 5; ABF – Aortobifemoral bypass graft;