ANGIOLOGIA E CIRURGIA VASCULAR
PUBLICAÇÃO OFICIAL SPACV

ORIGINAL ARTICLE

Ten Years of CERAB for Complex Aortoiliac Occlusive disease

Tiago Magalhães[a], **Ruy Fernandes e Fernandes**[a,b,c], **Ryan Gouveia e Melo**[a,b,c], **Carolina Passos**[a], **Luís Mendes Pedro**[a,b,c]

[a] Serviço de Cirurgia Vascular, Unidade Local de Saúde Santa Maria, Lisboa, Portugal
[b] Faculdade de Medicina da Universidade de Lisboa (FMUL)
[c] Centro Cardiovascular da Universidade de Lisboa (CCUL@RISE)

Submitted: April 23, 2025; Reviewed: December 27, 2025; Accepted: April 5, 2026

ABSTRACT

INTRODUCTION: Covered Endovascular Aortic Repair (CERAB) has previously been shown to be a viable treatment option for patients with aortoiliac occlusive disease. However, data reporting on the technique is still scarce, and durability remains a concern. The aim of this study was to conduct a descriptive analysis of our experience and to evaluate the outcomes of CERAB over the last 10 years.

METHODS: A retrospective, single-centre cohort study was conducted. From April 2015 to February 2025, we included all consecutive patients who underwent CERAB for aortoiliac occlusive disease. Outcomes were defined as primary patency rate, freedom from clinically driven target lesion revascularisation, and amputation-free survival at 12 and 36 months. Major adverse events were defined as a composite of myocardial infarction, stroke, bowel ischemia, respiratory insufficiency, acute limb ischemia or access-related complications.

RESULTS: A total of 23 patients (65% male) were included, with a mean age of 60.7 years (± 10.2). The most common clinical presentation was Rutherford classification grade 5 chronic ischemia (44%), and the majority (87%) had Transatlantic Inter-Society Consensus II (TASC II) D lesions. Technical success was achieved in 100% of cases. Major adverse events at 30 days were observed in 39%, with access-related complications the most common (17%). The median hospital stay was six days (range 3.0–15), and 30-day mortality occurred in one case. The median follow-up was 27 months (4.6–62.1). The primary patency rate was 84% and 77% at 12 and 36 months, respectively. The target lesion revascularisation freedom rate was 85% at 12 and 36 months, while the major amputation-free survival rate was 89% at the same time points.

CONCLUSION: The CERAB technique appears to be a feasible option for patients with extensive aortoiliac occlusive disease, including TASC II D lesions, demonstrating high technical success. Despite the small sample size, good mid-term outcomes were observed in a clinical and anatomically complex group of patients.

Keywords: Aortoiliac disease; CERAB; Kissing stent; Peripheral arterial disease

INTRODUCTION

The endovascular approach has become increasingly complex, continuously pushing the boundaries of what is considered possible and challenging established treatment guidelines. The TransAtlantic Inter-Society Consensus II (TASC II), published in 2007, recommends open surgery as the treatment of choice for extensive aortoiliac disease classified as TASC C and D.[1]

The use of kissing stents (KS) in the common iliac arteries has emerged as a viable option, achieving primary patency rates of approximately 90% and 80% at 12 and 24 months, respectively.[2] Furthermore, the COBEST trial demonstrated favourable patency outcomes using covered stents in TASC C and D aortoiliac lesions.[3]

Nevertheless, the geometry of kissing stents can create mismatch areas between the stent and the vessel wall, potentially causing flow disturbances. These disturbances

Corresponding Author:
Tiago Magalhães
Unidade Local de Saúde Santa Maria, Serviço de Angiologia e Cirurgia Vascular.
Avenida Professor Egas Moniz, 1649-028, Lisboa, Portugal.

DOI: https://doi.org/10.48750/acv.682

may result in recirculation, turbulence, and blood stasis, which can contribute to thrombosis and intimal hyperplasia.[4]

To address these anatomical and physiological limitations, the Covered Endovascular Reconstruction of the Aortic Bifurcation (CERAB) technique was introduced in 2013. In vitro studies have shown that CERAB provides superior flow geometry and more physiologic flow patterns compared to KS.[5,6] Early clinical outcomes have also been promising, with primary and secondary patency rates of 87-96%, and 97-98% at one year, respectively.[7-9]

The aim of this study was to provide a descriptive analysis of our experience and evaluate the outcomes of the CERAB technique over the past ten years.

METHODS

This study followed the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) reporting guidelines for cohort studies.

Study design, setting, and participants

We conducted a single-centre cohort study with a retrospective analysis of consecutive patients treated for aortoiliac occlusive disease who underwent the CERAB technique between April 2015 and February 2025. Each case was classified according to TASC II guidelines.

Patients with associated external iliac artery (EIA) disease, as well as common femoral artery (CFA), profunda femoral artery (PFA), and superficial femoral artery (SFA) disease, were also included.

In addition, adjunctive procedures were performed when necessary, including CFA endarterectomy, EIA angioplasty, and SFA angioplasty.

Imaging evaluation and procedural details

Prior to the procedure, all patients underwent a triphasic computed tomography angiography (CTA) of the abdomen, pelvis, and lower limbs. The image assessment included evaluation for complete total occlusions (CTOs) of the infrarenal aorta, CIA, and EIA; measurement of the longitudinal extension and degree of stenosis; determination of the maximal outer-to-outer wall diameter and minimal inner-to-inner lumen diameter of the aorta and iliac arteries; assessment of calcification severity, defined as follows: none, mild (<25% of vessel circumference calcified), moderate (25–50% of vessel circumference calcified), and severe (>50% of vessel circumference calcified); and evaluation of the patency of the inferior mesenteric artery (IMA). All CTAs were reviewed and interpreted by an experienced vascular surgeon.

Arterial access was determined on a case-by-case basis. Bilateral femoral access, either surgical or percutaneous, was most commonly employed. In selected cases, additional cutdown axillary access was used, primarily in challenging iliac recanalisations when femoral access was inadequate. In patients with concomitant CFA disease or requiring PFA revascularisation, surgical endarterectomy was performed initially, bilaterally if necessary.

The CERAB technique was performed using balloon-expandable covered stents, including Atrium Advanta V12®, Bentley BeGraft® Aortic, Peripheral and Peripheral Plus, and Gore® VBX stents. A large aortic stent was first deployed at nominal pressure; subsequently, post-dilatation of the proximal aortic stent segment was frequently required and was performed using a large non-compliant balloon, measured to the proximal aortic lumen diameter. In some cases, an additional larger aortic stent was placed proximally to enhance aortic coverage and optimize proximal stent apposition. Thereafter, the iliac stents were positioned simultaneously and deployed using a kissing stent technique.

When necessary, additional angioplasty of the residual CIA and EIA arteries was performed.

Post procedure, patients received statin treatment and dual antiplatelet therapy for at least six months, after which single antiplatelet and statin therapy was continued.

Outcomes, variables, and definitions

Collected data included patient demographics, risk factors, and comorbidities, including renal dysfunction, defined as glomerular filtration rate less than 60.0 mL/min/1.73m2, and cardiac disease (minor: asymptomatic, with remote myocardial infarction (›6 months); moderate: stable angina, ejection fraction 25% to 45%, asymptomatic arrhythmia, or history of congestive heart failure; severe: unstable angina, symptomatic or poorly controlled ectopy/arrhythmia, poorly compensated or recurrent congestive heart failure, ejection fraction of less <25%, myocardial infarction ≤6 months). The American Society of Anesthesiologists (ASA) physical status classification, clinical presentation (Rutherford classification), anatomical characteristics, and procedural details, including number and diameters of aortic and iliac stents, stent lengths, sacrifice of the IMA, procedural time, and intraoperative complications, were also recorded.

The primary endpoint was the primary patency rate (PPR), defined as the absence of occlusion in either one iliac branch or the entire CERAB configuration.

Secondary outcomes included secondary patency rate (SPR), freedom from clinically driven target lesion revascularisation (TLR) and amputation-free survival at 12 and 36 months. Major adverse events were also assessed and defined as a composite of myocardial infarction, stroke, bowel ischemia, respiratory insufficiency, acute limb ischemia, or access-related complications. Technical success was defined as successful CERAB stent deployment without early occlusion (≤30 days) or conversion to open surgery. Loss of CERAB patency was defined as occlusion of either one iliac branch or the entire CERAB configuration.

Statistical analysis

Statistical analysis was performed using SPSS version 31.0 (IBM Corp., Armonk, NY). Continuous variables are presented as mean ± standard deviation or median (IQR: Q1–Q3), as appropriate. Categorical variables are expressed as number (%). Comparisons were made using the Student's t-test or Mann–Whitney U test for continuous variables and the χ^2 or exact test (applied if more than 20% of cells had counts below 5) for categorical variables. Survival and patency were analysed using Kaplan–Meier curves. A two-tailed p value < 0.05 was considered statistically significant.

RESULTS

Patient demographics, risk factors, and comorbidities

A total of 23 patients were enrolled in the study. Fifteen patients (65%) were male, and the mean age was 60.7 ± 10.2 years.

The most common risk factors and comorbidities included hypertension, hyperlipidaemia, and tobacco use, each present in 78% of patients. Type 2 diabetes mellitus was observed in 9 patients (39%), and renal dysfunction in 5 patients (22%). Most patients (71%) were classified as ASA III or higher.

Minor and moderate cardiac disease were present in seven patients (30%), while severe cardiac disease was observed in one patient (4%).

Demographics, risk factors, and comorbidities are summarised in Table 1.

Clinical and anatomical presentation

In this cohort, 10 patients (44%) presented with Rutherford classification grade 5 chronic limb ischemia. Rutherford classifications 3 and 4 were each observed in six patients (26%). Regarding anatomical classification, 20 cases (87%) were classified as TASC II D lesions, and three cases (13%) as TASC II B.

Concerning aortic characteristics, CTO of the infrarenal aorta was observed in three patients (13%). Moderate-to-severe aortic calcification was noted in nine patients (38%). The mean aortic stenosis percentage was 41% ± 29%.

In the iliac arteries, right common iliac artery CTO occurred in three patients (13%) and left common iliac artery CTO in eight patients (35%). The mean degree of stenosis was 43% ± 35% in the right common iliac artery and 57% ± 37% in the left common iliac artery.

The IMA was occluded in seven patients (30%). EIA and femoral run-off are described in detail in Table 2.

Technical details

Technical details related to the procedures are summarised in Table 3.

Table 1. Demographics and comorbidities of patients treated with CERAB, included in the study

Age (in years) – mean (SD)	60.7 (10.2)
Sex (male) – N (%)	15 (65)
ASA score:	
2 – N (%)	7 (30)
3 – N (%)	13 (57)
4 – N (%)	3 (13)
Cardiac status:	
1 – N (%)	4 (17)
2 – N (%)	3 (13)
3 – N (%)	1 (4)
Coronary artery disease – N (%)	5 (21)
Hypertension – N (%)	18 (78)
Hyperlipidemia – N (%)	18 (78)
Smoking – N (%)	18 (78)
COPD – N (%)	4 (17)
Type 2 Diabetes Mellitus – N (%)	9 (39)
Renal dysfunction – N (%)	5 (22)
Baseline GFR# (mL/min/1.73m2) – median (IQR)	90.0 (71.5-102.5)
Baseline creatinine – median (IQR)	0.80 (0.67-1.09)
Previous stroke or TIA – N (%)	2 (9)

ASA – American Society of Anesthesiology physical status score; **COPD** – Chronic obstructive pulmonary disease; **GFR** – glomerular filtration;

Table 2. Clinical and anatomical presentation of patients treated with CERAB, included in the study

Rutherford Classification Chronic Ischemia	
3 – N (%)	6 (26)
4 – N (%)	6 (26)
5 – N (%)	10 (44)
TASC II	
B – N (%)	3 (13)
D – N (%)	20 (87)
Aortic CTO – N (%)	3 (13)
Aortic lesion length (mm) – mean (SD)	52.4 (18.4)
Aortic stenosis (%) – mean (SD)	41 (29)
Aortic calcification (moderate-severe) – N (%)	9 (38)
Right Iliac CTO – N (%)	3 (13)
Right Iliac stenosis (%) – mean (SD)	43 (35)
Right Iliac calcification (moderate-severe) – N (%)	14 (61)
Left Iliac CTO – N (%)	8 (35)
Left Iliac stenosis (%) – mean (SD)	57 (37)
Left Iliac calcification (moderate-severe) – N (%)	12 (52)
Right external iliac run-off	
No disease – N (%)	11 (48)
Stenosis – N (%)	7 (30)
Occluded – N (%)	5 (22)
Left external iliac run-off	
No disease – N (%)	8 (35)
Stenosis – N (%)	12 (52)
Occluded – N (%)	3 (13)
Inferior mesenteric artery	
No disease – N (%)	13 (57)
Stenosis – N (%)	3 (13)
Occluded – N (%)	7 (30)
Right Common femoral run-off	
No disease – N (%)	11 (48)
Stenosis – N (%)	7 (30)
Occluded – N (%)	5 (22)
Left Common femoral run-off	
No disease – N (%)	12 (52)
Stenosis – N (%)	8 (35)
Occluded – N (%)	3 (13)

CTO – Chronic total occlusion;

Table 3. CERAB procedure-related technical details

Aortic stents	
1 – N (%)	13 (57)
2 – N (%)	10 (43)
Stent aortic diameter (mm) – mean (SD)	12 (12-14)
Stent aortic length (mm) – median (IQR)	49.5 (39.5-60.5)
Post dilatation aortic stent – N (%)	16 (70)
CERAB covered stent distal landing zone	
CIA – N (%)	18 (78)
EIA – N (%)	5 (22)
Aortic covered stent type	
Advanta – N (%)	6 (26)
Bentley Aortic – N (%)	16 (70)
Gore VBX – N (%)	1 (4)
Iliac covered stent type	
Advanta – N (%)	7 (30)
Bentley peripheral – N (%)	12 (52)
Bentley peripheral plus – N (%)	3 (13)
Gore VBX – N (%)	1 (4)
Right Iliac stents n°	
1 – N (%)	12 (52)
2 – N (%)	7 (30)
3 – N (%)	3 (13)
4 – N (%)	1 (4)
Right Iliac stent diameter (mm) – median (IQR)	8.0 (7.0-8.0)
Right Iliac stent total length (mm) – median (IQR)	59.0 (57.0-100.0)
Left Iliac stents n°	
1 – N (%)	16 (70)
2 – N (%)	4 (17)
3 – N (%)	3 (13)
Left Iliac stent diameter (mm) – median (IQR)	8.0 (7.0-8.0)
Left Iliac stent total length (mm) – median (IQR)	59.0 (57.0-100.0)
Occlusion of the inferior mesenteric artery – N (%)	15 (65)
Chimney-CERAB – N (%)	1 (4)
Total operation time (min) – mean (SD)	179 (85)
Technical success – N (%)	23 (100)
Intra procedural complications – N (%)	4 (17)
CFA_EA – N (%)	10 (43)
EIA stent – N (%)	13 (57)

CIA – common iliac artery; **EIA –** external iliac artery; **CFA –** common femoral artery; **EA –** endarterectomy

In the CERAB configuration, the aortic stents had a median diameter of 12 mm (12–14 mm) and a median length of 59 mm (49–59 mm). Sixteen cases required proximal post-dilatation of the aortic stent, with a median diameter of 16 mm (14–18 mm).

In 16 cases (70%), the distal landing zone of covered stents on the CERAB configuration was in the CIA, while in 7 cases (30%) it extended into the EIA.

The median diameter of the iliac stents used was 8 mm, and in most cases, only one stent was necessary for each side. Bentley® BeGraft Peripheral was the most commonly used iliac stent (52%), followed by Atrium® Advanta V12 (30%).

Sacrifice of the IMA occurred in 15 patients (65%), excluding patients with a previously occluded IMA. Additional procedures included CFA endarterectomy in 10 cases (43%) and EIA angioplasty with stenting in 13 cases (56%).

The mean total operative time, including both open and endovascular segments, was 179 ± 85 minutes, and technical success was achieved in 100% of cases.

Intraoperative complications occurred in 4 patients (17%), including 1 access-site complication (brachial thrombosis resolved with thrombectomy), 1 external iliac artery rupture with hemorrhagic shock, and 2 cases of stent deployment failure or migration. In one of the latter cases, incomplete iliac stent deployment with inability to detach the stent in the intended position required retrieval up to the subclavian artery, where full deployment was achieved, followed by relining. In the second case, partial aortic stent collapse required CERAB relining, with technical success.

Short-term outcomes and early re-intervention

Short-term outcomes and secondary interventions within the first 30 days are summarised in Table 4.

Table 4. Short-term outcomes and early re-interventions of patients treated with CERAB, included in the study

Major Adverse Events – N (%)	9 (39)
Myocardial Infarction – N (%)	1 (4)
Urinary tract infection – N (%)	1 (4)
Stroke – N (%)	1 (4)
Acute kidney injury – N (%)	2 (9)
Bowel ischemia – N (%)	0
Access complication – N (%)	4 (17)
Early re-intervention	
CERAB configuration related – N (%)	1 (4)
CERAB unrelated – N (%)	5 (22)
Hospital stay (days) – median (IQR)	6 (3-15)
30 days Mortality – N (%)	1 (4)

Major adverse events occurred in 9 patients (39%), with access-related complications being the most frequent (n=4, 17%). There was one case of myocardial infarction and one stroke, and two cases of acute kidney injury. No cases of bowel ischemia were reported.

Early reinterventions were necessary in six patients (26%). In one case, stent re-linning of external iliac artery was necessary, due to non-occlusive thrombus. The remaining five interventions included two CFA repairs due to access site complications, one infra-inguinal revascularization, and two amputations (one minor and one major).

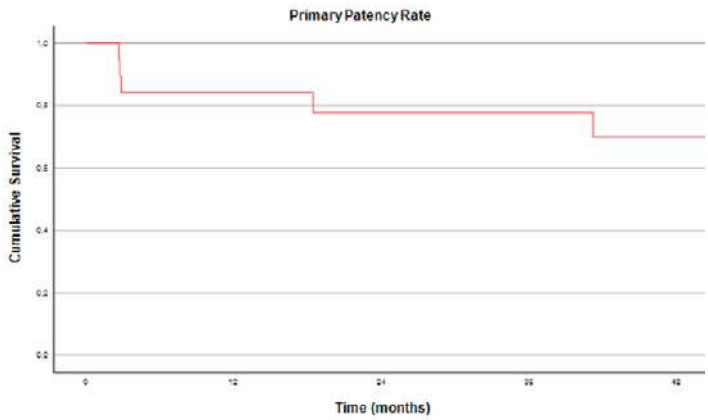
The median hospital stay was six days (interquartile range, 3–15 days).

Thirty-day mortality rate was 4% (n=1), attributed to cardiac complications.

Follow up Outcomes

Considering the follow-up period, the overall median follow-up was 27 months (interquartile range [IQR]: 4.6–62.1 months). The PPR was 84% at 12 months, 77% at 36 months (Figure 1). During follow-up, five losses of CERAB patency were observed, including four cases of iliac stent occlusion and one occlusion of the entire CERAB configuration. The secondary patency rate was 90% and 83%, at the same points, respectively.

Figure 1. Kaplan Meier curves for the primary patency of patients treated with CERAB



Months of follow-up	0	12	24	36	48
At risk	23	15	13	11	8
Survival %	100	89.5	83.1	83.1	74.8
SE	0	0.070	0.090	0.090	0.113

Univariate analysis revealed no statistically significant association between patient comorbidities and CERAB occlusion. Also, no significant differences were found regarding technical and procedural details, including the type of stent used.

Univariate analysis of risk factors for CERAB occlusion is presented in Table 5.

Table 5. Univariable analysis of risk factors for CERAB occlusions.

Variable	No Occlusion (n=18)	Occlusion (n=5)	P value
Sex (male) – N (%)	12 (67)	3 (60)	1.00
Cardiac status:			0.38
1 – N (%)	2 (11)	2 (40)	
2 – N (%)	3 (17)	0	
3 – N (%)	1 (6)	0	
Renal dysfunction– N (%)	5 (28)	0	0.54
TASC II			0.53
B – N (%)	2 (11)	1 (20)	
D – N (%)	16 (89)	4 (80)	
Aortic CTO – N (%)	3 (17)	0	1.00
Aortic lesion length (mm) – mean (SD)	55.3 (19.4)	42.4 (14.2)	0.18
Aortic lesion smallest luminal diameter (mm) – mean (SD)	6.4 (3.9)	9.2 (3.5)	0.17
Aortic stenosis (%) – median (IQR)	34 (25-63)	35 (4-45)	0.39
Aortic calcification (moderate-severe) – N (%)	8 (44)	1 (20)	0.61
Iliac CTO – N (%)	9 (50)	1 (20)	0.33
Right Iliac lesion length (mm) – mean (SD)	44.8 (17.1)	33.4 (13.0)	0.18
Right Iliac lesion smallest luminal diameter (mm) – mean (SD)	4.4 (2.6)	2.4 (2.3)	0.12
Right Iliac stenosis (%) – median (IQR)	27 (19-57)	40 (25-100)	0.31
Right Iliac calcification (moderate-severe) – N (%)	11 (61)	3 (60)	1.00
Left Iliac lesion length (mm) – mean (SD)	43.0 (20.9)	32.8 (21.3)	0.34
Left Iliac lesion smallest luminal diameter (mm) – mean (SD)	2.6 (2.7)	5.2 (1.6)	0.06
Left Iliac stenosis (%) – median (IQR)	75 (25-100)	33 (12-49)	0.09
Left Iliac calcification (moderate-severe) – N (%)	10 (56)	2 (40.0)	0.64
Right external iliac run-off			0.06
No disease – N (%)	10 (56)	1 (20)	
Stenosis – N (%)	6 (33)	1 (20)	
Occluded – N (%)	2 (11)	3 (60)	
Right Common femoral artery run-off			0.06
No disease – N (%)	10 (56)	1 (20)	
Stenosis – N (%)	6 (33)	1 (20)	
Occluded – N (%)	2 (11)	3 (60)	
Left external iliac run-off			0.70
No disease – N (%)	7 (39)	1 (20)	
Stenosis – N (%)	9 (50)	3 (60)	
Occluded – N (%)	2 (11)	1 (20)	
Left Common femoral artery run-off			0.12
No disease – N (%)	10 (56)	2 (40)	
Stenosis – N (%)	7 (39)	1 (20)	
Occluded – N (%)	1 (6)	2 (40)	

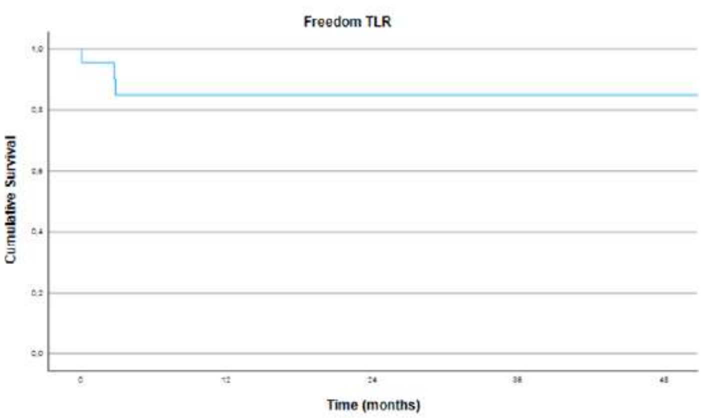
Aortic stents 1 – N (%) 2 – N (%)	9 (50) 9 (50)	4 (80) 1 (20)	0.33
CERAB distal landing zone CIA – N (%) EIA – N (%)	14 (78) 4 (22)	2 (40) 3 (60)	0.14
Right Iliac stents 1 – N (%) 2 – N (%) 3 – N (%) 4 – N (%)	10 (56) 5 (28) 2 (11) 1 (5)	2 (40) 2 (40) 1 (20) 0	0.82
Iliac stent type Advanta – N (%) Bentley peripheral/plus – N (%) Gore VBX – N (%)	5 (28) 12 (67) 1 (6)	2 (40.0) 3 (60.0) 0	0.15
Left Iliac stents 1 – N (%) 2 – N (%) 3 – N (%)	13 (72) 3 (17) 2 (11)	3 (60) 1 (20) 1 (20)	0.84
CFA_EA with patch – N (%)	6 (33)	4 (80.0)	0.12
EIA stent – N (%)	9 (50.0)	4 (80)	0.33

CIA – common iliac artery; **EIA –** external iliac artery; **OR –** operation time; **CFA –** common femoral artery; **EA –** endarterectomy ; **CTO –** chronic total occlusion

During the follow-up period, 11 reinterventions were performed, of which four were related to TLR. Two were due to common iliac stent occlusion: one was treated with recanalization and relining with a new stent, and the other with thrombectomy. The remaining two TLR cases were related to iliac stent stenosis, requiring iliac kissing-stent relining in one case and external iliac artery stent relining in the other. Additionally, three major amputations were recorded.

The freedom from clinically driven TLR rate was 85% at 12 and 36 months, Figure 2.

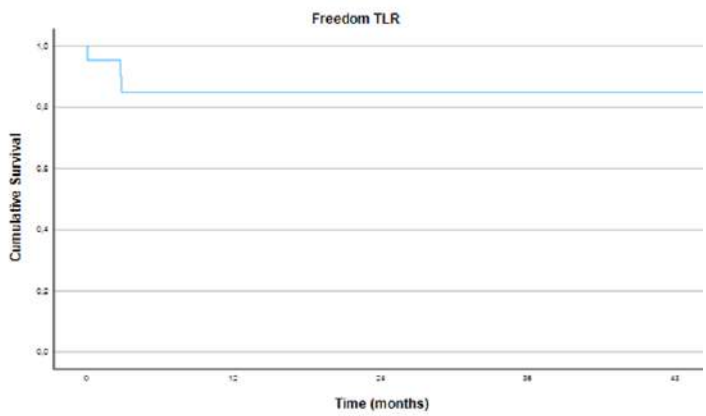
Figure 2. Kaplan-Meier curves for freedom from target lesion revascularisation



Months of follow-up	0	12	24	36	48
At risk	23	15	12	10	8
Survival %	100	84.8	84.8	84.8	84.8
SE	0	0.081	0.081	0.081	0.081

The major amputation-free survival rate was 89% at both 12 and 36 months, Figure 3.

Figure 3. Kaplan-Meier curves for amputation-free survival.



Months of follow-up	0	12	24	36	48
At risk	23	15	12	10	8
Survival %	100	84.8	84.8	84.8	84.8
SE	0	0.081	0.081	0.081	0.081

DISCUSSION

In this study, we present the experience of a single centre since the introduction of the CERAB technique and its outcomes during follow-up. A total of 23 cases were performed, with primary patency rates of 84% at 1 year and 77% at 3 years of follow-up. These patency rates are comparable to those reported in the existing literature, such as the series described by Taeymans et al, who reported a PPR of 82% at three years.[10]

According to TASC II recommendations, extensive aortoiliac lesions classified as C and D should preferably be treated with open surgery.[1] However, in our cohort, we observed cases of complex disease, with the majority classified as TASC II D, including aortic CTOs in 13% of cases, moderate to severe aortic calcification in 38%, and iliac calcification in up to 61% of cases. Despite this complexity, a 100% technical success rate was achieved.

In the systematic review and meta-analysis published by Salem et al. in 2021, aortobifemoral bypass demonstrated PPRs of 96% and 93% at 1 and 3 years, respectively, while the CERAB technique showed PPRs of 88% and 82% over the same time periods.[11] However, when comparing 30-day morbidity and mortality, the endovascular approach showed a significantly safer profile, with morbidity rates of 10% versus 15% and 30-day mortality rates of 0% versus 3% for CERAB and open surgery, respectively. In our study, postoperative complications were observed in 35% of cases; however, most complications were related to vascular access, and the small sample size makes this figure susceptible to considerable variation.

In the univariate analysis of risk factors for patency loss, no clinical, anatomical, or technical variable with a statistically significant association was found with CERAB occlusion. Nevertheless, a 2020 systematic review comparing open surgery and endovascular revascularisation for aortoiliac disease found that patients undergoing hybrid surgery with femoral endarterectomy had superior primary patency rates than those undergoing endovascular revascularisation alone.[12] Although well-established predictors of CERAB failure remain unknown, Grimme et al described three major causes of loss of primary patency.[7] First, they emphasised the importance of covering the entire diseased artery—from healthy to healthy segments—to minimise outflow obstruction. The second factor involves collapse or kinking of the iliac stent, which can be associated with highly calcified lesions, especially in small-diameter iliac arteries/stents. Finally, poor adherence to therapy was highlighted, underscoring the importance of antiplatelet or anticoagulation strategies. The small size of our series represents a limitation, increasing the risk of a type II statistical error and precluding the identification of risk factors or predictors associated with loss of CERAB patency. In the present study, clinically driven TLR was defined as reintervention performed after symptom onset and confirmed by complementary imaging. Freedom from clinically driven TLR was 85% at both 12 and 36 months, comparable to previously published results reporting freedom from TLR rates of 88% at 1 year and 86% at 2 years. [7] Secondary patency rates in our cohort were 90% at 12 months and 83% at 36 months. Although a meta-analysis by Salem et al. reported higher secondary patency rates at three years, endovascular aortic reconstruction remains an attractive alternative to open surgery, offering lower perioperative morbidity and mortality, shorter hospital stay, and the possibility of treating patients unfit for open repair, while achieving acceptable long-term outcomes.[11]

Despite up to 30% of patients presenting with Rutherford classification category 3, freedom from major amputation was high (89% at three years), corresponding to only four amputations during follow-up, further supporting the safety and effectiveness of this approach. Although limited by sample size, our cohort reflects the real-world population commonly treated, including significant comorbidities and varied surgical risk profiles. Not all aortoiliac lesions are indicated for CERAB, as disease confined to the iliac arteries may be managed with kissing stents, and the need to preserve the inferior mesenteric artery may limit its use. Nevertheless, in extensive longitudinal disease, including proximal involvement, CERAB appears to be a feasible and effective option, even if it challenges current guideline recommendations.

CONCLUSION

The CERAB technique showed satisfactory mid-term outcomes for complex aortoiliac occlusive disease. Despite lesion complexity, technical success reached 100%, and freedom from clinically driven reintervention remained high during follow-up.

Although our study has limitations, the results support CERAB as a safe and effective alternative to open surgery, especially in high-risk patients.

Larger prospective studies are needed to validate these findings, improve patient selection, and refine long-term management strategies.

Acknowledgements: None

Conflicts of interest: None

Funding: None

Data availability: By request to authors

Ethics Approval: Not applicable

Informed Consent: No written informed consent was required due to the study design

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process: No generative AI or AI-assisted technologies were used in the writing process.

REFERENCES

1. Norgren L, Hiatt WR, Dormandy JA, Nehler, Harris KA, Fowkes FGR. Inter-Society Consensus for the Management of Peripheral Arterial Disease (TASC II). J Vasc Surg 2007;45:S5–67.

2. Jebbink EG, Holewijn S, Slump CH, Lardenoije J-W, Reijnen MMPJ. Systematic Review of results of kissing stents in the Treatment of aortoiliac Occlusive Disease. Ann Vasc Surg 2017;42:328–36.

3. Mwipatayi BP, Sharma S, Daneshmand A, Thomas SD, Vijayan V, Altaf N, et al. Durability of the balloon-expandable covered versus bare-metal stents in the Covered versus Balloon Expandable Stent Trial (COBEST) for the treatment of aortoiliac occlusive disease. J Vasc Surg 2016;64:83-94

4. Jebbink EG, Mathai V, Boersen JT, Sun C, Slump CH, Goverde PCJM, et al. Hemodynamic comparison of stent configurations used for aortoiliac occlusive disease. J Vasc Surg 2016;66:251-60

5. Grimme FAB, Spithoven JH, Zeebregts CJ, Scharn DM, Reijnen MMPJ. Endovascular Treatment of Occlusive Lesions in the Aortic Bifurcation with Kissing Polytetrafluoroethylene-Covered Stents. J Vasc Intervent Radiol 2015;26:1277–84.

6. Jebbink EG, Grimme FAB, Goverde PCJM, Van Oostayen JA, Slump CH, Reijnen MMPJ. Geometrical consequences of kissing stents and the Covered Endovascular Reconstruction of the Aortic Bifurcation configuration in an in vitro model for endovascular reconstruction of aortic bifurcation. J Vasc Surg 2014;61:1306–11.

7. Grimme FAB, Goverde PCJM, Verbruggen PJEM, Zeebregts CJ, Reijnen MMPJ. Editor's choice – First results of the covered endovascular Reconstruction of the Aortic Bifurcation (CERAB) technique for aortoiliac occlusive disease. Eur J Vasc Endovasc Surg 2015;50:638–47.

8. Bontinis V, Bontinis A, Giannopoulos A, Manaki V, Kontes I, Papas T, et al. Covered endovascular reconstruction of the aortic bifurcation: A systematic review aggregated data and individual participant data meta-analysis. J Vasc Surg 2023;79:1525-35

9. Semaan DB, Habib SG, Abdul-Malak OM, Siracuse JJ, Madigan MC, Salem KM, et al. Aortobifemoral bypass vs covered endovascular reconstruction of aortic bifurcation. J Vasc Surg 2024;80:459-65

10. Taeymans K, Jebbink EG, Holewijn S, Martens JM, Versluis M, Goverde PCJM, et al. Three-year outcome of the covered endovascular reconstruction of the aortic bifurcation technique for aortoiliac occlusive disease. J Vasc Surg 2017;67:1438–47.

11. Salem M, Hosny MS, Francia F, Sallam M, Saratzis A, Saha P, et al. Management of Extensive Aorto-Iliac Disease: A Systematic Review and Meta-Analysis of 9319 patients. CardioVasc Intervent Radiol 2021;44:1518–35.

12. Premaratne S, Newman J, Hobbs S, Garnham A, Wall M. Meta-analysis of direct surgical versus endovascular revascularization for aortoiliac occlusive disease. J Vasc Surg 2020;72:726–37.