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Hybrid Revascularization for Extensive Iliofemoral Occlusive Disease

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Background: Total occlusion of the iliac-femoral tract can cause a variety of life-limiting symptoms ranging from mild claudication to chronic limb-threatening ischemia. Efforts should be made to revascularize the symptomatic ischemic limb. Currently there are different options in the vascular surgeon's armamentarium to achieve this. The aim of the study was to verify the feasibility and outcomes of inflow hybrid revascularizations combining femoral endarterectomy and recanalization of iliac atherosclerotic occlusion.

Methods: A retrospective review was conducted of all hybrid revascularizations involving femoral endarterectomy and endovascular treatment of iliac occlusion. The operations were performed in Helsinki University Hospital between January 2013 and December 2018. First, information about patients' baseline characteristics, indications and details of surgery and technical/hemodynamic success, and complications and mortality were obtained from the vascular registry and patients records. Secondarily, a prospective assessment of mid-term patency was performed through follow-up in November 2019. Immediate technical success, 30-day mortality, complications, and patency were considered major outcomes. Hemodynamic improvement, amputation rate, and overall mortality were also assessed.

Results: One hundred sixty three iliofemoral occlusions were performed on 147 patients during the period studied. Six patients (3.6%) had infrarenal aortic occlusion, 86 (52.7%) had common iliac, and 128 (78.5%) had external iliac artery occlusion. Technical success rate was 88.3% ($n = 144$ occlusions recanalized). Primary technical success was somewhat lower in lesions $\geq$ 90 mm (87.1%) compared to lesions shorter than 90 mm (95.7%; χ^2 $P = 0.06$). Iliac stent was deployed in 141 (94.6%) cases, 51 (34.3%) of which were covered stents. Significant residual stenosis remained in 1.2% of cases. Median operative time was 4 hr 34 min (interquartile range 2 hr 43 min) and median estimated blood loss was 743 mL (interquartile range 500 mL). Five patients (3.0%) developed a deep groin infection and 12 (8.1%) suffered any major cardiovascular event or stroke perioperatively. Primary patency at 30 day, 6 months, 1 year, and 2 years was 98.7%, 98.1%, 96.6%, and 93.7%, respectively. Hemodynamic success was documented in 107 patients (73%). By the end of the follow-up, 7 iliofemoral tracts (11.1%) reoccluded, 2 limbs (1.2%) required amputation, and 50 patients (3.0%) died.

Conclusions: Good immediate success rate and mid-term patency can be achieved by hybrid revascularization of iliofemoral occlusions. Careful patient selection is mandatory because this population often suffers from universal atherosclerosis. The involvement of the aorta represents a significant determinant of worse long-term patency, although it did not preclude technical success.

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INTRODUCTION

Total occlusion of the iliofemoral arteries due to peripheral arterial disease can cause a variety of life-limiting symptoms ranging from mild claudication to chronic limb-threatening ischemia (CLTI). Earlier the standard revascularization method was aortobifemoral bypass (ABFB), but nowadays endovascular techniques have replaced open surgery and in many centers the majority of the patients are treated with recanalization, percutaneous transluminal angioplasty, and stenting of the occluded segments. Classically occlusions affecting the common femoral artery were considered not suitable for a purely endovascular approach due to anatomical challenges; stenting of this area has high risk of in-stent restenosis or secondary thrombosis of the deep femoral artery.[1,2] Recent reports on endovascular treatment are optimistic; however, when it comes to thrombosis of the femoral bifurcation, an open approach is in most vascular centers the rule because it provides longer patency.[3,4] Hybrid procedures combining simultaneous femoral endarterectomy and endovascular recanalization of the occluded iliac arteries offer an alternative approach. The potential benefits of this intervention compared to ABFB are related to the minimal dissection and surgical trauma, less complications, length of hospital stay, and quicker recovery after surgery.[5]

Traditional ABFB is a dependable option with a heavy body of evidence supporting its long-term patency and low rates of perioperative complications.[6−8] However, ABFB requires the patient to be fit enough to undergo a laparotomy. Extra-anatomical reconstruction in the form of femoro-femoral cross-over bypass or axillofemoral bypass is an option for frail patients but is associated with lower patency rates and risk of graft infection in patients with CLTI and gangrene or tissue lesions.[9−12]

During recent years, preliminary reports on the hybrid approach have been promising.[13−16] European Guidelines on Peripheral Artery Diseases published in 2017 support a hybrid approach in iliofemoral lesions.[17] These reports are mostly based on transatlantic inter society consensus II classification focusing on C or D type, thus reporting results on a variety of lesions including stenoses and usually few occlusions. Moreover, some reports define patency in terms of lack of reintervention without adequate surveillance.[13] Because stenosis and occlusion might represent a different level of technical difficulty and long-term patency, it is important to analyze them independently to draw adequate conclusions and to be able to compare the results with ABFB.

We aimed to study the technical success and mid-term results in patients with total occlusion in the iliofemoral arteries treated with a hybrid approach combining femoral endarterectomy and endovascular treatment of iliac occlusion.

METHODS

Data Collection

Using the local vascular registry (HUSVASC) we identified all patients who underwent a hybrid procedure including femoral endarterectomy and endovascular treatment of the common or external iliac artery between 2013 and 2018. We selected only patients with occlusion in the iliac artery based on preoperative magnetic resonance angiography or computer tomography angiography scans. Baseline characteristics, the American Society of Anesthesiologists (ASA) scores, Rutherford classification at the baseline, and details on operative/perioperative treatment were acquired from the electronic patient records. Baseline characteristics included hypertension, smoking status, diabetes mellitus, coronary artery disease (CAD), chronic kidney disease, chronic occlusive pulmonary disease, cerebrovascular disease, history of transient ischemic attack or stroke, and use of statin medication. International Classification of Diseases 10 codes, HUSVASC registry, and patient records were used in the data collection process.

Our primary outcome measures were:

1. Immediate technical (i.e., successful recanalization of the occlusion without significant [$>$ 30%] residual stenosis in the final angiogram);
2. 30-day mortality;
3. Incidence of 30-day major complications: aortic dissection, acute myocardial infarction (troponin elevations and electrocardiography changes consistent with myocardial infarction), stroke (acute stroke in brain CT scan), renal complication (acute kidney injury needing dialysis), respiratory complication (pneumonia, acute respiratory insufficiency), bleeding or occlusion (leading to reoperations), and deep surgical site infection (only infections involving the femoral vessels and needing debriding and coverage with sartorius muscle flap); and
4. Patency during follow-up.

Our secondary outcomes were:

1. Hemodynamically significant improvement in ankle brachial pressure (ABI) ($\geq$ 0.10) or toe

pressure (TP) (> 15 mm Hg) at 30 days and in the late check-up;
2. Overall mortality; and
3. Overall amputation rate.

Furthermore, we recorded the information on operation duration, intraoperative bleeding, and the number of femoro-femoral of iliofemoral bypass operations due to unsuccessful endovascular revascularizations.

Operative Technique

All operations were performed by a vascular surgeon or a supervised trainee in a hybrid operating room equipped with a floor-fixed C-arm (Artis Zeego, Siemens, Erlangen, Germany). Concomitant femoral endarterectomy was performed either prior to the endovascular procedure or thereafter at the surgeon's discretion. After full heparinization and arterial clamping, all occlusive material was removed from femoral bifurcation extending proximally up to the external iliac artery, paying special attention to the origin of the deep femoral artery. Vascu-Guard (Synovis, St. Paul, Minnesota) or bovine pericardium patch (Xenosure, LeMaitre Vascular Inc, Burlington, Massachusetts) was used for the angioplasty. In most cases, the endarterectomy was performed prior to the endovascular procedure and access was obtained by direct puncture of the patch with an 18-gauge needle and subsequent placement of a 6F sheath over the wire. In a few cases, endarterectomy was performed after recanalization of the iliac segment. The technique has been described earlier.[18]

All recanalizations were attempted first by retrograde access from the common femoral artery. In case of failure, an antegrade access through either contralateral femoral artery (cross-over) or brachial artery was used. Covered stents (CSs) or bare metal stents (BMSs) were used. When also the distal aorta was involved, we used either 3-stent Covered Endovascular Reconstruction of Aortic Bifurcation or in case of short aortic lesion in distal aorta, 2 kissing stents to open the aortic bifurcation.[19] Finally, additional out-flow revascularizations were performed as per the preoperative magnetic resonance angiography or intraoperative angiogram.

Postoperative Follow-Up and Medication

Postoperative antithrombotic treatment included 1−3 months dual antiplatelet therapy (ASA 100 mg and clopidogrel 75 mg once daily) followed by single antiplatelet therapy with ASA 100 mg once daily. For patients who had permanent anticoagulation, only ASA 100 mg was added for 1−3 months. Follow-up extended until February 2020.

During the outpatient visit, all patients underwent clinical assessment, ABI and TP measurements, and duplex ultrasound (DUS) examination. First follow-up was at 1−3 months. Patients with Rutherford classification 5−6 continued surveillance until the wound was healed. To evaluate the mid-term and long-term success, all study patients were invited for an additional follow-up appointment by November 2019.

Statistical Analysis

All the data were primarily collected and tabulated using Excel version 2016 (Microsoft Corp, Redmond, Washington). Categorical variables are presented as frequencies and percentages and continuous variables as mean and range or median and interquartile range (IQR) depending on the type of distribution. Estimated Kaplan−Meier survival curves were generated for primary and secondary patency and survival. A multivariable binary logistic regression was used to elucidate comorbidities and factors affecting technical and hemodynamical success, patency, 30-day mortality, and complications. Pearson's Chi-squared or Log-Rank tests were used to assess statistically significant effects on each outcome at a significance level < 0.05.

Comorbidities that were included in the univariate analysis were age, gender, diabetes mellitus, hypertension, CAD, cerebrovascular disease, chronic kidney disease, smoking status, and the use of statins. Variables were included in the Cox proportional hazards model if they proved significant in the univariate analysis. Cox regression analysis using iterative maximum likelihood algorithm was applied to examine the effect of baseline characteristics and technical factors of interest (length of the lesion, stent type, and length and diameter of the stent) on the long-term patency. Fisher's scoring was used to fit the model and Hosmer−Lemeshow method was implemented to assess goodness of fit. Analysis was carried out with the use of SPSS version 25.0 (SPSS I. 2017. IBM SPSS statistics 25, New York: IBM Corp.) except for the proportional hazard model where R version 3.6.0 (Team R.C., 2013. R: A language and environment for statistical computing) was used.

RESULTS

The search identified 147 patients, who underwent a hybrid procedure due to total occlusion in either

Fig. 1. MRA of patient undergoing hybrid revascularization, both the common and external artery are occluded.

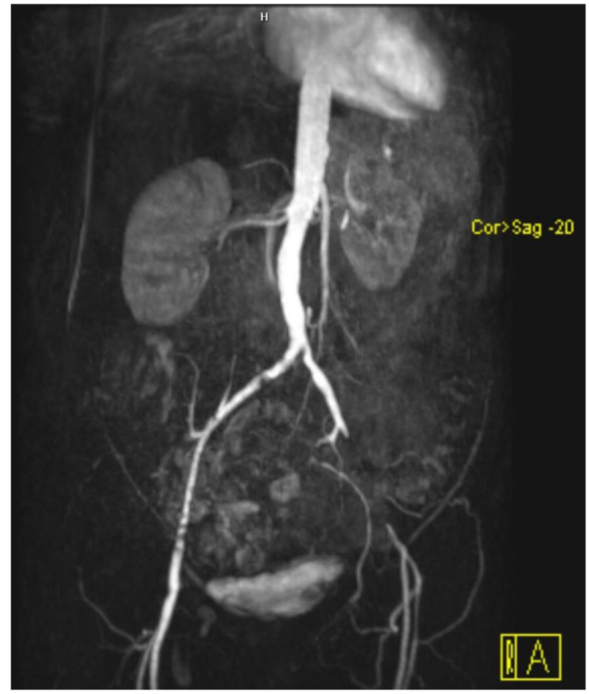

Fig. 2. MRA of patient undergoing hybrid revascularization. Iliac external artery is occluded.

1 (n = 131) or both (n = 16) iliofemoral arteries. Figures 1 and 2 exemplified the typical MRA of patients undergoing this type of procedure. Baseline characteristics and lesion lengths are presented in Table I. Concomitant outflow revascularization was performed in 28 limbs: 13 endovascular superficial femoral artery revascularizations and 15 distal bypasses. Median operative time was 4 hr 34 min (IQR 2 hr 43 min). Median estimated blood loss was 500 mL (IQR 700 mL). Neither time nor bleeding correlated with the likelihood of developing complications. Other procedures' details are presented in Table II.

Primary Outcomes

Immediate technical success. Rate was 88.3% ($n = 144/163$). In 15 (9.2%) cases satisfactory lesion crossing was not achieved and the operation was converted into an open procedure including 13 femoro-femoral cross-over bypasses and 2 iliofemoral bypasses. In 4 cases (2.4%) successful recanalization was done but residual stenosis remained (30%−50% of normal vessel diameter). Longer occlusions extending to the distal part of aorta were more challenging and primary technical success was somewhat lower in lesions ≥ 90 mm (87.1%) compared to lesions less than 90 mm (95.7%; χ^2 $P = 0.06$).

30-day mortality. Twelve patients (8.2%) died during the first 30 days after the primary operation. There were 6 in-hospital deaths: in 1 patient (0.6%) iatrogenic dissection of the aortic arch led to cardiac tamponade and death, 4 patients (2.7%) died of acute myocardial infarction, and 1 (0.7%) developed an acute stroke postoperatively. The rest of the early deaths ($n = 6$, 4.1%) happened after the patient's discharge to different care/rehabilitation facilities due to reasons mostly related to baseline comorbidities. In a univariate analysis, 2 factors increased the perioperative death risk: patient's age ($P = 0.006$) and postoperative complications ($P < 0.001$). Risk of perioperative death was higher in patients operated on an emergency setting (χ^2 $P = 0.014$).

Despite the fact that all early deaths except 1 happened among patients suffering from CLTI (n = 12, 8.2%), no significant statistical difference was found between different Rutherford categories (χ^2 $P = 0.07$).

30-day complications. Within 30 days after surgery, 5 cases (3.0%) of acute thrombosis occurred, 2 (1.2%) of which were successfully rescued by emergency thrombectomy, while the other 3 (1.8%) underwent bypass surgery. Overall complications were reported in 26 procedures (16%) and they are listed

Table I. Demographics, nature of the lesion, and perioperative risk score, *n* (%) or mean (SD)

Age in years	70 (9.4)
Men	91 (61.9)
Hypertension	110 (74.8)
Smoking (current/former)	80 (54.4)/48 (32.6)
Dyslipidemia	117 (79.6)
COPD	39 (26.5)
Coronary artery disease	60 (40.8)
Diabetes (yes/insulin)	47 (31.9)/29 (19.7)
Cerebrovascular disease	24 (16.3)
Chronic renal insufficiency (yes/dialysis)	17 (11.5)/4 (2.7)
Chronic atrial fibrillation	24 (16.3)
ASA category	
2	7 (4.7)
3	81 (55.1)
4	59 (40.1)
Rutherford indication	
2	34 (20.8)
3	32 (19.3)
4	51 (31.2)
5	37 (22.6)
6	9 (5.5)
TASC	
C	40 (24.5)
D	123 (75.5)
Occlusion	
Length in mm	95 (48.8)
Involvement	
Aorta	6 (3.6)
Common iliac	86 (52.7)
External iliac	128 (78.5)
Elective/emergency	118/45

COPD, chronic obstructive pulmonary disease; ASA, American Society of Anesthesiologists; TASC, transatlantic inter society consensus.

Table II. Procedural information, *n* (%)

Recanalization access	
Retrograde	122 (82.4)
Antegrade (contralateral cross-over)	20 (13.5)
Antegrade (brachial)	6 (4.1)
Endarterectomy (EA) prior to endovascular procedure	126 (77.3)
Stent placed over the EA[a]	62 (44.2)
Stent employed in each segment treated[b]	
No stent	9 (6.8)
Bare metal stent (BMS)	88 (59.4)
Covered	34 (22.9)
Both types	17 (11.4)
Location of the stent	
CIA	32 (22.7)
EIA	39 (27.6)
Multiple[c]	69 (49.2)

[a]100% corresponds to 140 limbs that received a stent.
[b]100% corresponds to a number of successful recanalizations.
[c]Includes any combination of locations: Aortic and common iliac, aortic and external iliac, and common and external iliac).

in Table III. The most common complication was acute myocardial infarction ($n = 11$, 6.7%). The only covariate that showed significant correlation with the immediate postoperative complications in the multivariate logistic regression model was CAD ($P = 0.001$).

Patency. All patients alive by November 2019 ($n = 97$, 66.8%) were contacted by phone and invited to a follow-up visit. Fifty eight patients refused to attend; all of them were asymptomatic. Thirty nine patients (26.5%) underwent follow-up assessment including ABI, TP, and DUS. The mean follow-up period was 28.8 months (range 1–94.8 months). DUS surveillance identified 4 restenoses of the iliac artery, 2 of which were asymptomatic. Seven iliofemoral arteries occluded during follow-up (all of which caused limb claudication). This yields a primary patency at 6 months, 1 year, and 2 years of 98.1%, 96.6%, and 93.7%, respectively (Table IV). These patients required further revascularization: all restenosis ($n = 4$, 2.4%) and 4 occlusions (2.4%) underwent successful endovascular recanalizations yielding a secondary patency of 98.7%, 97.3%, and 96.3% at 6 months, 1 year, and 2 years, respectively (Table IV). The remaining 3 occlusions (1.8%) underwent bypass surgery.

After multiple binary logistic regression analyses for each outcome at 12-month follow-up, primary patency failure rate was 21.8% higher when there was a concomitant aortic stenosis compared to a healthy aorta (Log-Rank $P < 0.001$). The impact of the aortic status continued till the end of the follow-up (failure rate 21.3%, Log-Rank $P < 0.001$); survival analysis is presented in Figure 3. Neither the length of the stent nor the length of the occluded lesion affected patency significantly regardless of the number of stents deployed. Proportional hazard regression was consistent with these findings after adjusting with all the covariates and factors.

Impact of the stent type. A total of 10 patients treated with any stent (5 with BMS versus 5 with a CS; Log-Rank $P = 0.26$) required target lesion revascularization during follow-up. Kaplan–Meier curve analysis disclosed a significant difference regarding secondary patency between patients

Table III. < 30 days complications, *n* (%)

AMI	11 (6.7)
Aortic dissection	1 (0.6)
Stroke	1 (0.6)
Pneumonia/acute respiratory insufficiency	4 (2.4)
Acute kidney insufficiency	1 (0.6)
Acute thrombosis	5 (3.0)
Wound infection[a]	5 (3.0)
Death	12 (8.1)

AMI, acute myocardial infarction.
[a]Deep infection requiring debridement in the operating theater and Sartorius muscle flap.

with BMS versus those with a CS in favor of BMS (Log-Rank $P < 0.02$) (Fig. 4).

Secondary Outcomes

1. Median ABI improvement was 0.25 (IQR: 0.39), whereas median TP improvement was 9 mm Hg (IQR: 37 mm Hg). Hemodynamic success was therefore documented in 107 patients (73%).
2. Over the follow-up, 50 patients (34.0%) died. Mortality was higher among CLTI patients than among claudicants (40.4% vs. 12.1%, $P < 0.001$). Estimated survival at 6 months, 1 year, and 2 years was 86.4%, 83.0%, and 74.6%, respectively (Table IV). Figure 5 compares mortality over time between the 2 groups.
3. Only 2 amputations (1.2%) were performed, both on CLTI patients. By the end of the follow-up, 8 more limbs (4.9%) required reintervention on the run-off.

DISCUSSION

In patients with aortoiliac disease extending to the femoral segment, hybrid in-flow operation offers an interesting third option between traditional open and endovascular. Previous knowledge presents it as a feasible revascularization method.[14,15,20,21] We explored the boundaries of the in-flow hybrid operations in a cohort of patients composed solely of occluded iliofemoral arteries.

Technical Success

Previous reports on hybrid revascularizations considered total occlusions only as part of the inclusion criteria; in other words, reports tend to include a mix of lesions ranging from mild stenosis to complete occlusions. Conclusions from these reports can hardly be used on the occlusion subgroup. This is mostly because recanalization of completely occluded iliac arteries represents a bigger challenge than passing through stenosis. The largest series so far comes from a recent multicenter registry in Italy where 713 patients suffering from aortoiliac occlusive disease underwent either endovascular or hybrid revascularization. The authors report an impressive 99.3% technical success rate regardless of the type of lesion. All the unsuccessful lesion-crossing happened in the transatlantic inter society consensus D subgroup ($n = 5$, 1.8%) which comprises longer obstructions.[15] We found in our single-center experience a more modest immediate success rate of 88.3% which is consistent with the intuitive idea that occlusions of the iliofemoral segment represent more demanding lesions than stenoses. Moreover, in our series, longer lesions were more difficult to recanalize. Our results are in line with the report of Chang et al. where 171 patients, 41% of whom had occlusions, underwent an in-flow hybrid intervention. The authors stated that one obstacle to use this technique is inability to cross long iliac lesions, but this obstacle has largely been overcome by an increased use of re-entry devices.[11] The success rate for the occlusion subgroup is not reported separately in neither of the aforementioned studies.

Mortality and Complications

Perioperative complications are strongly dependent on patient's comorbidities and burden of disease. Surgery on claudicants tends to be uneventful, whereas CLTI patients are at a higher risk. This might explain the differences in reported complication rates varying from 2% to 22%.[13,22] The proportion of patients with CLTI in our cohort is considerable (77.9%); despite of this, complications are not higher than those previously published.

Prolonged operative duration is a well-known risk factor for perioperative death and complications.[23] Nevertheless, it is inconsistently reported in the literature. We found that the mean procedure time for an in-flow hybrid operation lies inside the margins published for ABFB.[6,24,25] The only publication on hybrid revascularizations reporting operative duration presents similar times than our series: 340 min.[20] In our series, in addition to the hybrid procedure, many patients underwent distal bypass surgery, prolonging the duration of the procedure. Procedural bleeding on the other hand stays well under the reported 1,091−1,126 mL on average for ABFB.[6,24] Although in our series both time and bleeding were lower than with open repair, we found considerably high perioperative mortality (8.1%). Only older studies from the 80s report this

Table IV. Primary patency, secondary patency, and survival over time

	30 days	6 months	12 months	24 months
Primary patency	98.7%	98.1%	96.6%	93.7%
Secondary patency	99.4%	98.7%	97.3%	96.3%
Survival	92.5%	86.4%	83.0%	74.6%

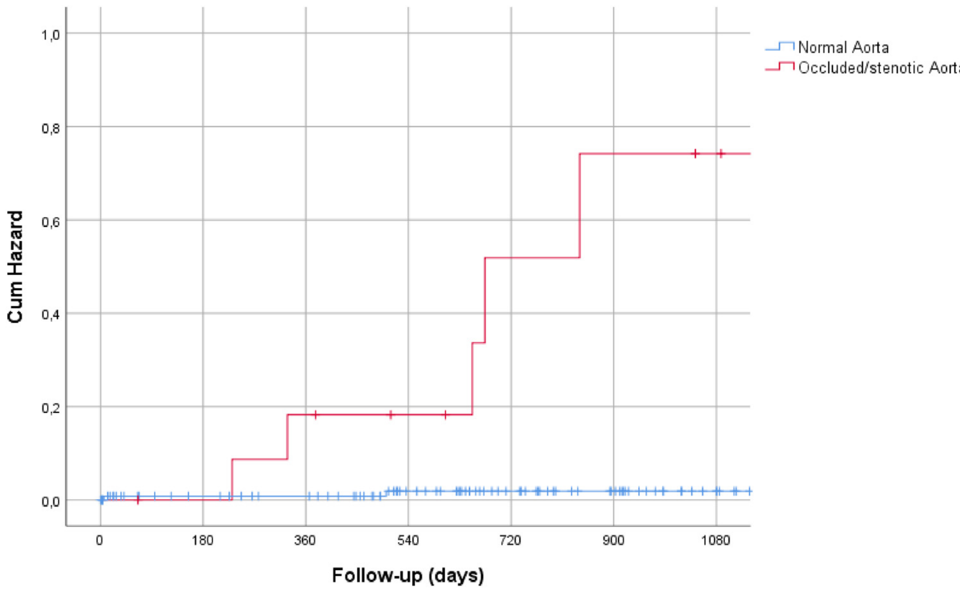

Fig. 3. Cumulative hazard over time of patients with normal aorta (*n* = 146 blue) and patients with stenotic aorta (*n* = 17 red). Multiple Cox regression analysis has shown that the presence of aortic stenosis was associated with an increased hazard ratio of primary patency failure.

level of perioperative mortality.[26,27] The rationale of this finding might be related to patients' baseline rather than to the operative technique; 59 patients in our cohort (40.1%) correspond to ASA IV category. We also found a statistically significant correlation between CAD and early death. Furthermore, a high prevalence of diabetes and renal insufficiency in the cohort also speaks for the patients' fragility. On the other hand, claudicants, who, by definition had less extensive arterial disease, had understandably lower mortality. In our cohort, emergency surgery also increases perioperative mortality as already presented in the literature.[28]

Aortic dissection is a very rare event during cardiovascular interventions and might be related to heavy calcifications or aggressive catheter manipulation.[29] The one patient who died of aortic dissection in our cohort represents the only inside-the-operating room death. The patient had calcified aortic arch and had a previous history of iatrogenic iliac dissection. In this particular case, the recanalization was attempted from brachial artery access and the distal part of the long 5F sheath stuck in the iliac artery and broke into 2 pieces leaving a wire between them that caused the aortic dissection. As per the manufacturer's instructions for use, these sheaths should always be removed with the dilator inside the sheath to prevent sheath breakage.

Patency

Patients with stenotic or occluded aorta had poorer outcome in the mid-term and long-term patency; this may be explained by heavier burden of disease. Interestingly, it did not impact the technical success.

Breaking down the patency results by type of stent discovered longer patency for patients with BMS versus those with CS. This is not aligned with current evidence coming from multicenter studies as the Covered versus Balloon Expandable Stent trial[30] or COBRA registry study.[31] These 2 research works analyzed relapsing of the disease under slightly different terms. Freedom binary restenosis in the case of COBRA and freedom from target

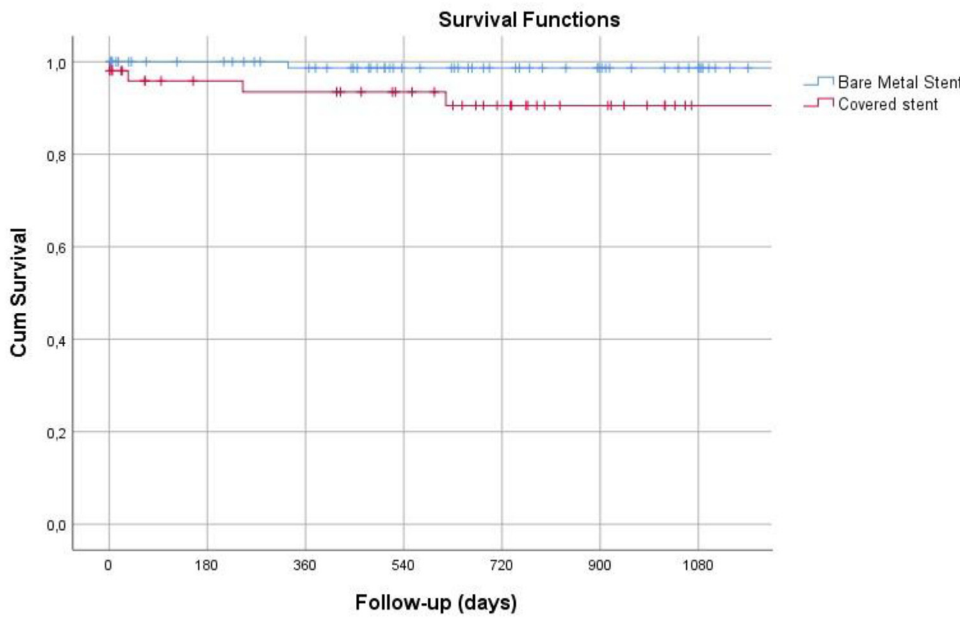

Fig. 4. Secondary patency of patients treated with BMS versus CS (log-rank $P < 0.02$).

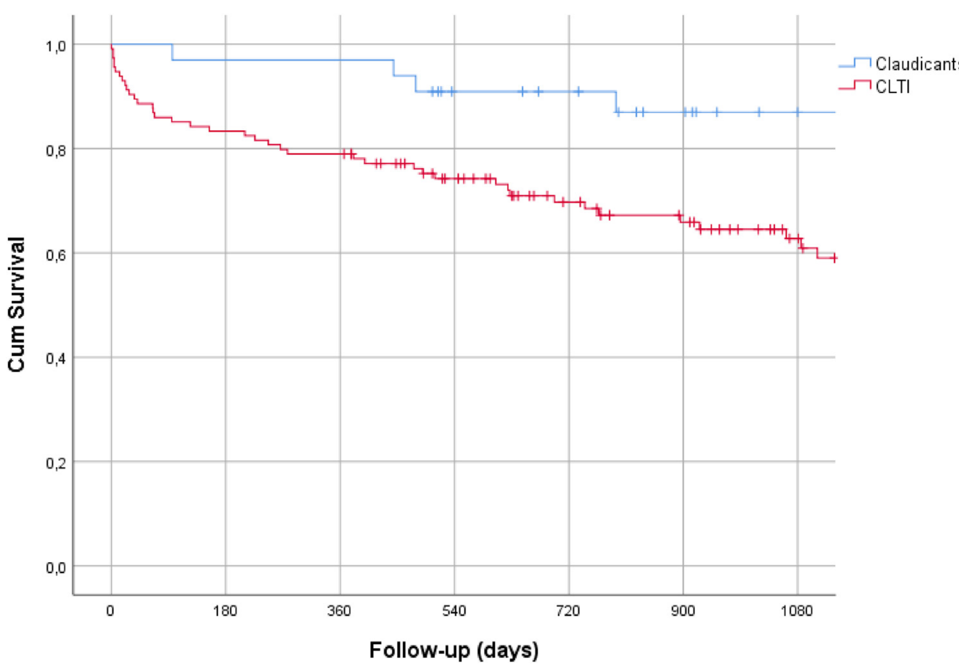

Fig. 5. Survival of claudicants versus patients with CLTI.

lesion revascularization in the case of the COBRA study. Despite the differences in terminology, both works found improved patency for complex iliac and aortoiliac occlusions when using CS versus BMS. Why we did not observe improved patency with CS is unclear, total length of stent might have a role, stenting all areas affected by occlusion or accepting the use of only percutaneous transluminal angioplasty in some, is something that in all these studies was left to the operator's discretion. Neither the length of the lesion nor the presence of diabetes seemed to affect patency, contrary to what was observed by Spanos et al.[32] Women have high rates of peripheral arterial disease and worse outcomes after revascularization despite fewer cardiovascular disease risk factors.[33,34] Our results, nevertheless, did not find neither gender-related differences in patency after adjusting for age.

Interestingly, among the patients who underwent the ad hoc clinical checkup, a small fraction developed restenosis (2.4%), and of them, only half were asymptomatic. This raises the question whether follow-up for this population group is necessary at all because relapsing of symptoms is rather rare. This however remains unclear because more than half of the patients did not attend the reassessment and the patency could not be verified. Further studies could explore whether so promising long-term results as we found here are the norm.

Over these years of complex hybrid revascularizations we have learned that heavily calcified lesions are more difficult to cross with a wire, which is not a surprise. Also, we tend to perform the femoral endarterectomy prior to endovascular part to be able to cross the lesion x-over and land always inside the true lumen despite subintimal recanalization. Surprisingly to us, chronic total occlusions hardly ever cause distal embolization when treated endovascularly.

Limitations of the Study

This is a retrospective study not designed to prospectively investigate the impact of stent characteristics or the status of the aorta and the results should be interpreted cautiously. Despite the lack of randomization and limitations inherent to the research methodology, vascular registries are nonetheless a valid alternative to achieving understanding of treatment feasibility and critical factors impacting outcomes. To our knowledge, no other research has previously validated hybrid methods specifically for occluded iliofemoral lesions. The findings presented suggest that even in severe cases of complete lumen thrombosis, the feasibility of the in-flow hybrid procedure is not compromised and long-term patency rates are commendable.

CONCLUSION

Hybrid revascularization of iliofemoral occlusions is a good option for patients with aortoiliac occlusion and concomitant significant lesion in femoral artery in terms of patency and perioperative complications. Patient selection is important because associated mortality in these procedures is not negligible, especially in CLTI patients. Long lesions (> 90 mm) represent a bigger technical challenge, although do not compromise the patency in the long term. The involvement of the aorta represents a significant determinant of worse long-term patency, but it did not preclude technical success.

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