Outcomes of the single-stent versus kissing-stents technique in asymmetric complex aortoiliac bifurcation lesions

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Objective: **This study investigated the outcomes of single-stent vs kissing-stents techniques in asymmetric complex aortoiliac bifurcation (ACAB) lesions.**

Methods: **We retrospectively investigated 80 consecutive patients (69 males, 66.6 ± 8.7 years) treated with a single stent and 30 patients (26 males, 67.1 ± 7.7 years) treated with kissing stents for ACAB between January 2005 and December 2012 from a single-center cohort. A ACAB lesion was defined as a symptomatic unilateral common iliac artery stenosis (>50%) combined with intermediate stenosis (30%-50%) in the contralateral common iliac artery ostium. The primary end point was the primary patency of the ACAB.**

Results: **The baseline clinical characteristics did not differ significantly between the single-stent and the kissing-stents group. Technical success was achieved in all patients. The single-stent group required fewer stents (1.3 ± 0.5 vs 2.3 ± 0.8; $P < .001$) and less bilateral femoral access (55% vs 100%; $P < .001$). Two patients in the single-stent group (3%) required bailout kissing stents because of plaque shift to the contralateral side. The major complication rates were 8% in single-stent vs 13% in the kissing-stent group, which was similar ($P = .399$). At 3 years, the single-stent and kissing-stents group had similar rates of primary patency (89% vs 87%; $P = .916$) and target lesion revascularization-free survival (93% vs 87%; $P = .462$).**

Conclusions: **The single-stent technique in ACAB was safe and showed midterm outcomes comparable with those of kissing stents. Considering the benefits, such as fewer stents, less bilateral femoral access, and the availability of contralateral access for future intervention, the single-stent technique may be an advantageous treatment option in ACAB. (J Vasc Surg 2015;62:68-74.)**

With the rapid evolution of endovascular therapy devices and experience of practitioners, increasingly complex peripheral artery lesions are becoming candidates for endovascular treatment. Endovascular intervention is now the preferred option for treating obstructive atherosclerotic diseases of the distal aorta and iliac arteries. Recent European guidelines recommend an endovascular-first strategy for aortoiliac Trans-Atlantic Inter-Society Consensus for the Management of Peripheral Arterial Disease (TASC) II type A, B, and C lesions.[1] The kissing-stents technique, first described by Kuffer et al,[2] has been adopted for endovascular treatment of complex aortoiliac bifurcation lesions involving the distal aorta and bilateral ostia of common iliac arteries (CIAs).[3] Even asymmetric aortoiliac lesions involving unilateral CIA ostium have been treated with kissing stents due to concerns about unfavorable plaque shifting and embolization to the contralateral iliac artery.[3,4]

However, the kissing-stents technique requires more devices, bilateral femoral artery access, and usually results in a loss of the future contralateral access option for endovascular treatment of distal lesions. Currently, there is no generally established consensus on how to treat unilateral aortoiliac bifurcation lesions. Especially, if a unilateral bifurcation lesions has an intermediate stenosis in the contralateral CIA ostium, whether the single-stent or kissing-stents technique is a better stenting strategy remains unknown. Thus, the purpose of the present study was to compare the outcomes of the single-stent vs kissing-stents techniques for the treatment of asymmetric complex aortoiliac bifurcation (ACAB) lesions.

METHODS

The protocol of this study conforms to the ethical guidelines of the 1975 Declaration of Helsinki. The Institutional Review Board approved this study and waived the requirement for informed consent due to its retrospective design.

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Study population. We retrospectively reviewed angiographic findings of 439 patients who received endovascular treatment with stent implantation for atherosclerotic aortoiliac diseases from January 2005 to December 2013. Of these patients, 110 met the following inclusion criteria: presence of symptomatic unilateral CIA stenosis (>50%) and intermediate stenosis (30%-50%) in the contralateral CIA ostium, according to a catheter-based angiography, and aortoiliac bifurcation lesions treated with a single stent or kissing stents. We excluded aortoiliac diseases without involvement of the CIA ostium (lesions >1 cm distal from the bifurcation), aortoiliac bifurcation lesions with significant (>50%) stenosis of the adjacent aorta, or aortoiliac bifurcation lesions previously treated with stents.

The study included 110 patients, of which 80 were treated with a single stent and 30 were treated with kissing stents. Before the angioplasty procedure, all patients underwent physical evaluations, a noninvasive hemodynamic evaluation (including segmental blood pressures, ankle-brachial index [ABI], and pulse volume recording), and at least one imaging test (computed tomography [CT], magnetic resonance angiography, or color duplex ultrasound imaging).

Procedure and periprocedural management. Procedures were routinely performed under local anesthesia supported by intravenous sedatives with cardiopulmonary monitoring. After puncture, heparin (5000 IU) was administered intra-arterially. Additional doses of heparin were added during the procedure, if necessary, to maintain an activated clotting time >250 seconds.

In general, single stents were implanted using a retrograde approach via the ipsilateral common femoral artery (CFA) or using a crossover approach via the contralateral CFA, whereas kissing stents were implanted using a bilateral retrograde CFA approach. In cases where the distal aorta or CIA was totally occluded, additional brachial artery access was obtained at the operator's discretion.

Lesions were crossed with 0.018-inch or 0.035-inch wires. In cases of total occlusion, the intraluminal or intentional subintimal technique was used for passage of wires, according to the operator's preference. All lesions with stenosis >50% were predilated using balloons (6-8 mm) smaller than the reference vessel diameter. Predilated lesions were routinely treated by implantation of a Palmaz Genesis (Cordis, Warren, NJ) or Express (Boston Scientific, Natick, Mass) balloon-expandable stent, or Smart (Cordis, Miami Lakes, Fla), Zilver (Cook Medical, Bloomington, Ind), Absolute Pro LL (Abbott Vascular, Abbott Park, Ill), or Hercules (S & G Biotech, Seongnam, Gyeonggi-do, Korea) self-expandable stents. Self-expandable stents were usually preferred for long-segment or tortuous lesions, whereas balloon-expandable stents were generally used for short-segment lesions of the CIA. Stent diameters ranged from 7 to 10 mm. Balloon-expandable stents were chosen to match the vessel size. Self-expandable stents were 1 mm oversized to the vessel diameter.

In the single-stent technique, a stent was implanted to cover the ostium of the target CIA with minimal protrusion of the stent into the aorta, without obstructing the entry into the contralateral iliac artery. In the kissing-stents technique, two stents were implanted, one in each CIA, protruding into the aorta and making parallel contact. All self-expandable stents were routinely postdilated to the reference vessel size. Additional poststent dilation was performed for all stents where residual stenosis was >30%.

All patients received maintenance doses of aspirin (100 mg) and clopidogrel (75 mg) for at least 5 days before the procedure or loading doses of aspirin (250 mg) and clopidogrel (300 mg) 1 day before the procedure. After the procedure, dual-antiplatelet therapy of aspirin (100 mg) and clopidogrel (75 mg) was maintained for at least 1 month.

Follow-up. Patients were evaluated after discharge in regular clinical follow-up visits at 3-month intervals for 1 year and then at 6-month intervals thereafter. After the procedure, noninvasive hemodynamic evaluations were performed on all patients before discharge from the hospital and thereafter regularly every 6 months or in cases of symptom deterioration. At least one imaging test (CT angiography, color duplex ultrasound imaging, or intra-arterial angiography) was performed at 1 year, or in cases with a >0.15 decrement in ABI or if symptoms worsened by one Rutherford category during follow-up.

Definitions. The index target vessel was a symptomatic CIA with ostial stenosis >50% according to a catheter-based angiography. Technical success was defined as successful stent implantation at the target vessel with residual stenosis <30% on postprocedural angiography. The primary end point was the primary patency of both CIAs, defined as (1) the absence of binary restenosis (≥50%) measured by CT angiography, invasive angiography, or duplex ultrasound imaging, and (2) a decrease in ABI >0.15 between postprocedure and follow-up. Peak velocity >180 cm/s or a lesion/adjacent segment velocity ratio >2.4 by duplex imaging was considered a significant (≥50%) stenosis.

Secondary end points included survival free of target lesion revascularization (TLR) and major adverse events (MAEs). A MAE was defined as a composite of all-cause death, binary restenosis of the aortoiliac bifurcation, TLR, or unplanned amputation. Major procedural complications were defined as all-cause death, complications requiring intervention, or unplanned amputation ≤30 days after the procedure.

Statistical analysis. Continuous variables are expressed as means ± standard deviation and categoric variables as number and percentage. Comparisons of continuous variables between the single-stent and the kissing-stents group were performed using the Student *t*-test. Categoric variables were compared using a χ^2 or Fisher exact test, as appropriate. Comparisons of variables before and after the procedure were performed using a paired *t*-test. Primary and secondary end points were determined using Kaplan-Meier survival analysis and

Table I. Baseline clinical characteristics

Characteristics[a]	*Single stent (n = 80)*	*Kissing stent (n = 30)*	P *value*[b]
Age, years	66.6 ± 8.7	67.1 ± 7.7	.786
Male gender	69 (86)	26 (87)	.955
BMI, kg/m^2	23.0 ± 3.1	23.3 ± 2.8	.667
Hypertension	57 (71)	24 (80)	.354
Diabetes mellitus	33 (41)	7 (23)	.082
Dyslipidemia	61 (77)	25 (83)	.484
Current smokers	44 (55)	16 (53)	.876
Chronic kidney disease	11 (14)	6 (20)	.419
Coronary artery disease	58 (73)	16 (53)	.056
Congestive heart failure	12 (15)	4 (13)	.825
Symptoms			.198
Claudication	71 (89)	29 (97)	
Critical limb ischemia	9 (11)	1 (3)	
Baseline TBI			
Ipsilateral[c]	0.58 ± 0.20	0.58 ± 0.18	.928
Contralateral	0.98 ± 0.20	0.95 ± 0.11	.573
Baseline ABI			
Ipsilateral[c]	0.50 ± 0.20	0.51 ± 0.18	.745
Contralateral	0.87 ± 0.23	0.85 ± 0.13	.628
Discharge medication			
Aspirin	80 (100)	30 (100)	−
Clopidogrel	73 (91)	28 (93)	.723
Statin	64 (80)	26 (87)	.419

ABI, Ankle-brachial index; *BMI,* body mass index; *TBI,* thigh-brachial index.
[a]Continuous data are shown as the mean ± standard deviation and categoric data as number (%).
[b]A *P* value <.05 is considered significant.
[c]The ipsilateral side is defined as the side of the stented vessel in the single-stent group and the side of the more severely diseased vessel in the kissing-stents group.

Table II. Lesion and procedural data

Variables[a]	*Single stent (n = 80)*	*Kissing stents (n = 30)*	P *value*
TASC II classification			.178
Type A/B	53 (66)	23 (77)	
Type C/D	27 (34)	7 (23)	
Chronic total occlusion	64 (81)	20 (67)	.112
Combined lesions			
External iliac artery	24 (30)	11 (37)	.504
Ipsilateral[b]	24 (30)	6 (20)	.294
Contralateral	8 (10)	8 (27)	.027
Femoropopliteal artery	39 (49)	10 (33)	.147
Ipsilateral[b]	30 (38)	6 (20)	.081
Contralateral	27 (34)	7 (23)	.292
Infrapopliteal artery	33 (41)	10 (33)	.449
Ipsilateral[b]	25 (31)	8 (27)	.640
Contralateral	27 (34)	8 (27)	.477
Access site			
Unilateral femoral artery	36 (45)	−	<.001
Bilateral femoral artery	44 (55)	30 (100)	
Brachial artery	10 (13)	4 (13)	.907
Combined treatment			
Femoropopliteal artery	25 (31)	2 (7)	.008
Ipsilateral[b]	21 (26)	1 (3)	.007
Contralateral	8 (10)	2 (7)	.588
Infrapopliteal artery	5 (6)	1 (3)	.549
Ipsilateral[b]	5 (6)	1 (3)	.549
Contralateral	1 (1)	0 (0)	.538
Implanted stents, No.	1.3 ± 0.5	2.3 ± 0.8	<.001
Stent type			.123
Balloon-expandable	60 (75)	18 (60)	
Self-expandable	20 (25)	12 (40)	

		Ipsilateral[b]	*Contralateral*	
Size of implanted stents				
Diameter, mm	8.2 ± 0.9	8.9 ± 1.8	9.0 ± 1.9	.017[c]
Length, mm	56.0 ± 27.8	62.5 ± 25.7	63.5 ± 24.6	.266[c]

TASC II, Trans-Atlantic Inter-Society Consensus for the Management of Peripheral Arterial Disease.
[a]Continuous variables are shown as the mean ± standard deviation and categoric variables as number (%).
[b]Ipsilateral side is defined as the side of the target common iliac artery (CIA).
[c]Comparison between the single-stent and the kissing-stents group in the ipsilateral CIA.

compared using a log-rank test. The risk factors for restenosis were evaluated using univariate and multivariate Cox regression analyses. The stenting strategy and variables with *P* values of < .15 in univariate analysis were entered into the multivariate analysis. Patients initially treated with a single stent who received bailout kissing stents were included in the single-stent group in all comparative analyses. Bailout kissing stenting was considered a TLR in the outcome analysis. Statistical analyses were conducted using IBM PASW Statistics 19.0 software (IBM Corp, Armonk, NY).

RESULTS

Baseline clinical and procedural characteristics. The enrolled patients were a mean age of 68 ± 9 years (range, 37-83 years). There were 100 patients (91%) with intermittent claudication and 10 (9%) with critical limb ischemia. Baseline clinical characteristics did not differ significantly between the single-stent and the kissing-stents group (Table I). Lesion and procedural data are summarized in Table II. The single-stent group required fewer stents than the kissing-stents group (1.3 ± 0.5 vs 2.3 ± 0.8; *P* < .001). The mean diameter of implanted stents in the single-stent group was slightly smaller than that in the kissing-stents group (8.2 ± 0.9 vs 8.9 ± 1.8 mm; *P* = .046). The single-stent group required less frequent bilateral femoral artery puncture than the kissing-stents group (55% vs 100%; *P* < .001).

No patients had significant stenosis in the contralateral CIA. However, the kissing-stents group showed more frequently combined lesions in the contralateral external iliac artery than the single-stent group (27% vs 10%; *P* = .027). There was no difference between the two groups in the frequency of combined femoropopliteal or infrapopliteal artery lesions. A total of 29 patients (26%) required concurrent treatment for ipsilateral or contralateral infrainguinal lesions. More patients in the single-stent group received combined treatment for femoropopliteal artery disease than those in the kissing-stents group (31% vs 7%; *P* = .008). Other characteristics were similar between the two groups.

Procedural outcomes. Early procedural outcomes at 30 days, including complications, are presented in Table III. Technical success for the target lesion was achieved in all patients in both groups. Differences in major procedural complications between the two groups were not significant. One death related to retroperitoneal bleeding occurred in the single-stent group and one cardiac death occurred in the kissing-stents group, which was not directly related to the procedure.

Two patients in the single-stent group underwent bailout kissing stenting due to unfavorable plaque shifting to the contralateral side. These events were considered cases of TLR. Three patients in the kissing-stents group experienced distal embolization to the contralateral side that required intervention (two endovascular and one surgical embolectomy). No patients in the single-stent group developed significant distal embolization. Postprocedural thigh-brachial index and ABI in the ipsilateral limb as well as in the contralateral limb did not differ between the two groups. Fig 1 shows a representative case of single-stent (*A-C*) and a case of bailout kissing-stents due to unfavorable plaque shift (*D-F*).

Midterm outcomes. Patients were monitored for 39.2 ± 27.7 months. During this period, 21 MAEs occurred, including 12 deaths (5 cardiovascular and 7 noncardiovascular causes), 1 unexpected minor amputation, 11 cases of restenosis, and 8 clinically driven TLRs after the procedure. The single-stent group experienced 16 MAEs, including 10 deaths (5 cardiovascular and 5 noncardiovascular causes), 8 cases of restenosis, 5 TLRs, and 1 unplanned minor amputation. The kissing-stents group had 2 deaths of noncardiovascular causes, 3 cases of restenosis, and 3 TLRs. Primary patency, TLR-free survival, and MAE-free survival after treatment of the ACAB lesions were not significantly different between single-stent and kissing-stents groups (Fig 2). The primary patency rates were excellent in the single-stent and kissing-stents groups, at 93% and 97% at 1 year and 89% and 87% at 3 years, respectively ($P = .916$ by log-rank test). Fig 3 shows the primary patency and the TLR-free survival in the target and contralateral CIA according to the stenting strategy. Primary patency rates and TLR-free survival rates were not significantly different between the single-stent and the kissing-stents group.

During the follow-up period, 10 patients (9%) underwent endovascular therapy for distal lower limb artery lesions. In the single-stent group, angioplasty procedures were performed in 2 external iliac, 2 femoropopliteal, and 2 tibial artery lesions. Endovascular treatments were performed in one external iliac and two tibial artery lesions in the kissing-stents group. These two tibial artery lesions were treated by an antegrade approach. Univariate and multivariate Cox regression analyses showed no significant independent risk factors for binary restenosis after stenting in the ACAB (Table IV). Only body mass index showed a trend toward an association with risk of restenosis in multivariate analysis (hazard ratio, 0.79, 95% confidence interval, 0.61-1.03; $P = .076$).

Table III. Early procedural outcomes at 30 days

Variables[a]	*Single stent (n = 80)*	*Kissing stents (n = 30)*	P *value*
Technical success	80 (100)	30 (100)	–
Major complications	6 (8)[b]	4 (13)	.399
Death	2 (3)	0 (0)	1.000
Procedure-related	1 (1)[b]	0 (0)	
Nonprocedural related	1 (1)	0 (0)	
Complications requiring interventions	5 (6)	4 (13)	.252
Plaque shift to contralateral side	2 (3)	0	1.000
Arterial rupture	1 (1)	0	1.000
Stent thrombosis	0	1 (3)	.273
Distal embolization	0	3 (10)	.019
Ipsilateral	0	1 (3)	
Contralateral	0	2 (7)	
Pseudoaneurysm	1 (1)	0	1.000
Retroperitoneal bleeding	1 (1)	0	1.000
Unplanned amputations	0	0	
Postprocedural hemodynamic data			
TBI			
Ipsilateral	1.01 ± 0.17	0.98 ± 0.17	.466
Contralateral	1.03 ± 0.16	1.06 ± 0.13	.466
ABI			
Ipsilateral	0.91 ± 0.22	0.91 ± 0.23	.850
Contralateral	0.94 ± 0.20	0.92 ± 0.17	.612

ABI, Ankle-brachial index; *TBI,* thigh-brachial index.
[a]Continuous variables are shown as the mean ± standard deviation and categoric variables as number (%).
[b]The cause of death was retroperitoneal bleeding.

DISCUSSION

Our main finding was that the single-stent technique was safe and achieved similar primary patency and TLR-free survival rates as the kissing-stents technique in the treatment of ACAB lesions. Although two patients in the single-stent group required bailout stenting in the contralateral CIA due to unfavorable plaque shift, the incidence of such a complication was low (3%) and was manageable by endovascular treatment. The advantages of the single-stent strategy were the use of fewer stents and a reduced need for bilateral femoral punctures.

Aortoiliac bifurcation lesions are defined as TASC II class A to D lesions depending on their extension into the proximal aorta and distal iliac arteries.[5] However, they are generally regarded as challenging targets to treat due to their high plaque burdens and the anatomical proximity of the aorta and both CIAs. To avoid potential risks, such as occlusion or embolization due to plaque shift and atherosclerotic progression in the contralateral vessel, Tegtmeyer et al[6] first proposed bilateral simultaneous balloon angioplasty for the treatment of aortoiliac bifurcation lesions. However, the kissing balloon alone was frequently associated with dissections and residual stenosis. Therefore, the kissing-stents technique with simultaneous bilateral implantation of stents has been used for the endovascular treatment of the aortoiliac bifurcation. Previous studies demonstrated high technical success and favorable

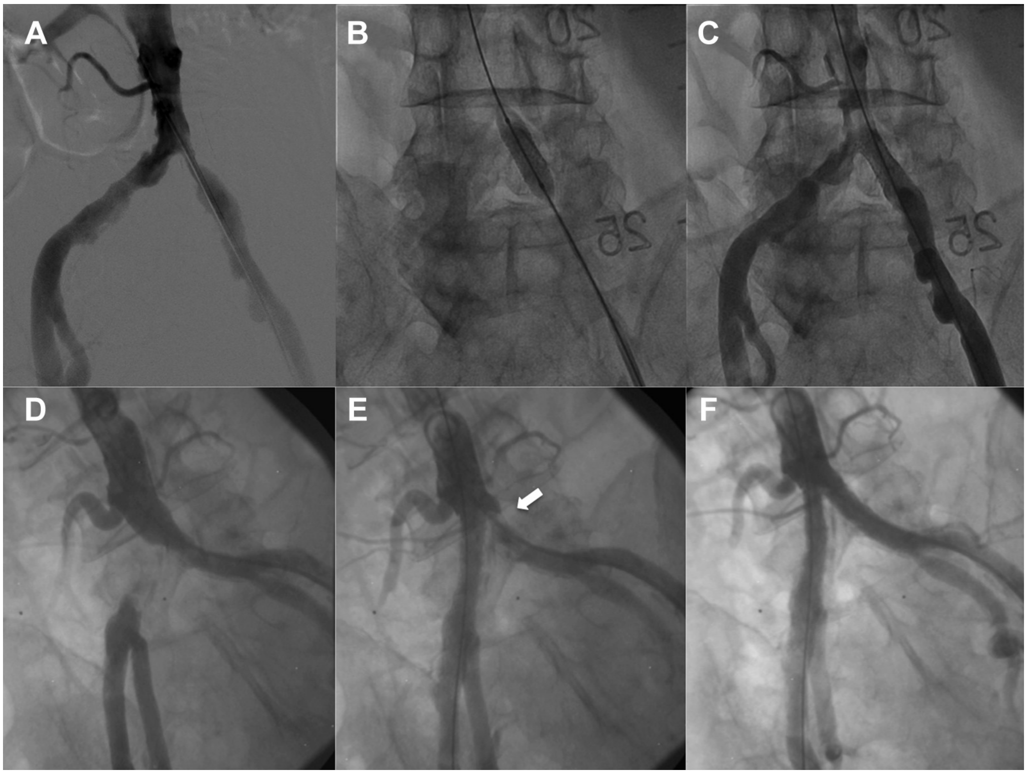

Fig 1. Representative patients with asymmetric complex aortoiliac bifurcation (ACAB) lesions. Single-stent technique: **(A)** preprocedural angiography; **(B)** implantation of an Express 8-mm × 27-mm balloon-expandable stent (Boston Scientific, Natick, Mass); and **(C)** final angiography. A patient with an ACAB lesion treated with bail-out kissing-stents: **(D)** preprocedural angiography; **(E)** implantation of a Palmaz Genesis 8-mm × 59-mm stent (Cordis, Miami Lakes, Fla) at the right common iliac artery (CIA), with resulting plaque shift to the contralateral CIA (*arrow*); **(F)** final angiography after additional implantation of a Palmaz Genesis 8-mm × 39-mm stent at the left CIA.

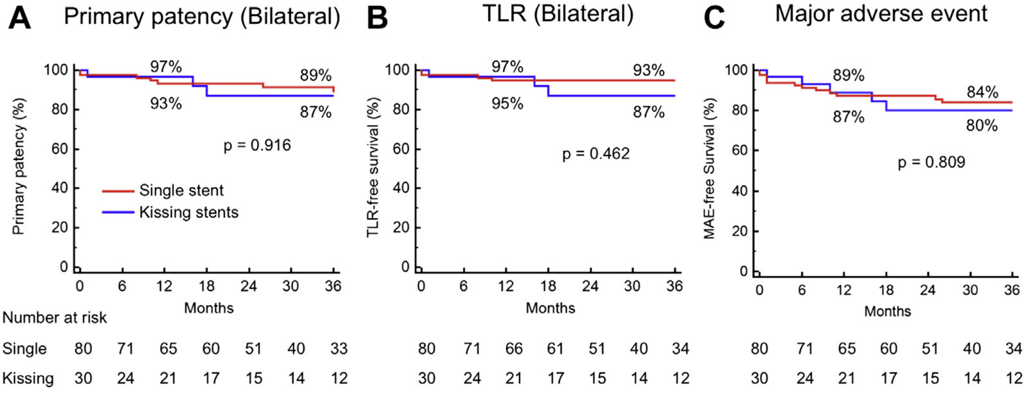

Fig 2. Midterm outcomes of the asymmetric complex aortoiliac bifurcation (ACAB) according to stenting technique: **(A)** primary patency, **(B)** target lesion revascularization (*TLR*)-free survival, and **(C)** major adverse event (*MAE*)-free survival. All standard errors <10%.

intermediate-term primary patency rates, ranging from 63% to 92%,[4,7-11] whereas other studies reported relatively poorer outcomes, with patency rates of 45% to 65%.[12-15] The inconsistency in immediate and later outcomes among previous studies may reflect heterogeneity in study populations, lesion characteristics, and procedural techniques.

Several studies have also described treatment of aortoiliac diseases with unilateral CIA stenosis using the kissing-stents technique[9,10,12]; however, these studies provided no detailed description of the procedural outcomes in this particular patient subgroup. In a single study, Mohamed et al[13] reported that there was no

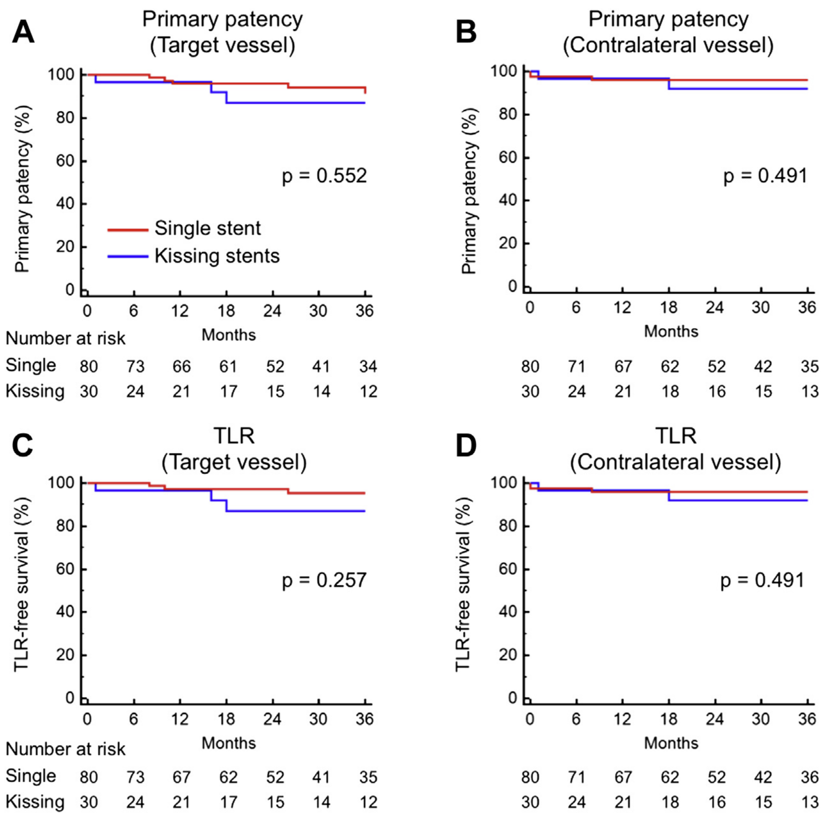

Fig 3. Primary patency is shown for **(A)** the target common iliac artery (CIA) and **(B)** the contralateral vessel, and target lesion revascularization (TLR)-free survival is shown for **(C)** the target CIA and **(D)** the contralateral vessel according to the stenting technique. All standard errors <10%.

Table IV. Risk factors of restenosis in the asymmetric complex aortoiliac bifurcation (ACAB)

	Univariate analysis		*Multivariate analysis*	
Factors	*HR (95% CI)*	P *value*	*HR (95% CI)*	P *value*
Age	0.93 (0.87-0.99)	.023	0.95 (0.89-1.01)	.124
Male	1.31 (0.17-10.38)	.798	—	
BMI	0.83 (0.67-1.04)	.102	0.79 (0.61-1.03)	.076
Hypertension	0.28 (0.08-1.06)	.034	0.42 (0.11-1.52)	.186
Diabetes mellitus	0.32 (0.07-1.51)	.149	0.33 (0.05-2.18)	.246
Dyslipidemia	2.28 (0.29-18.05)	.434	—	
Current smoking	4.05 (0.87-18.80)	.074	4.31 (0.72-25.89)	.110
Congestive heart failure	0.82 (0.10-6.45)	.846	—	
Chronic kidney disease	1.88 (0.50-7.08)	.354		
Critical limb ischemia	1.41 (0.18-11.26)	.745	—	
Combined femoropopliteal disease	2.19 (0.64-7.53)	.215		
TASC II C/D lesion	1.35 (0.39-4.60)	.636		
Chronic total occlusion	4.13 (0.52-32.77)	.179	2.91 (0.30-27.99)	.355
Single-stent strategy	0.93 (0.25-3.52)	.916	0.79 (0.19-3.24)	.740
Stent diameter	0.98 (0.62-1.53)	.914		
Stent length	1.01 (0.98-1.03)	.509		
Balloon-expandable stent	1.71 (0.36-8.00)	.497		

BMI, Body mass index; *CI,* confidence interval; *HR,* hazard ratio; *TASC II,* Trans-Atlantic Inter-Society Consensus for the Management of Peripheral Arterial Disease.

obstruction in 12 nondiseased contralateral CIAs after the kissing-stents procedure during a 3-year follow-up. Thus, there is limited information regarding outcomes with kissing stents or any other endovascular technique in unilateral aortoiliac bifurcation lesions. To our knowledge, this is the first report comparing outcomes between the kissing-stents and single-stent technique in ACAB lesions.

According to our experience, the single-stent technique in the ACAB led to midterm outcomes and postprocedural complication rates similar to those of the kissing-stents technique. In our study, only 3% of the patients treated with a single-stent required bailout kissing stents and >90% of the patients treated with a single-stent demonstrated patency in the contralateral CIA over 3 years. Therefore, the single-stent technique in patients with ACAB can be considered safe. However, the single-stent technique appears to be more cost-effective because it requires fewer stents and bifemoral access sites compared with the kissing-stents technique. More importantly, the single-stent strategy may be advantageous because it can preserve the crossover route for future endovascular intervention in distal lower limb arteries, whereas the kissing stents make the crossover passage of devices difficult. Multilevel disease involving the aortoiliac artery and femoropopliteal artery are not infrequent, especially in elderly patients with diabetes.[16] In our study, 45% of the patients had combined femoropopliteal disease and 39% had below-the-knee lesions. Approximately 25% of the enrolled patients required concurrent treatment for ipsilateral or contralateral distal lesions. Furthermore, during the follow-up period, 9% of the patients underwent endovascular treatment for distal lower limb artery diseases. Two patients from the kissing-stents group required endovascular treatment for distal tibial artery lesions during follow-up. Vascular access options in these patients were limited, and the procedure was performed by an antegrade approach. Thus, in patients with ACAB lesions, placement of a stent at the ostium of the CIA with minimal protrusion into the aorta, without obstructing the entry to the contralateral CIA, appears to be a considerable benefit for potential future endovascular interventions.

The major limitation of our study is its retrospective study design and the relatively small study population. We cannot rule out selection bias in the triage of bifurcation lesions for single-stent or kissing-stents strategies. In addition, we used angiography to assess the stenosis severity of the bifurcation lesion. We did not consider geometric variables, plaque quantity, or characteristics of the bifurcation lesions or detailed technical factors, such as balloon or stent size or products, in data analyses because of limited existing data and the small study volume. These factors may have an effect on the outcomes of the procedure. Large-scale prospective clinical studies are needed to address these issues.

CONCLUSIONS

The single-stent strategy was safe and as effective as the kissing-stents strategy in the treatment of ACAB lesions. Considering the benefits of fewer stents, less frequent bifemoral access, and the availability of crossover access for future intervention, the single-stent technique may be an advantageous treatment option in ACAB lesions.

AUTHOR CONTRIBUTIONS

Conception and design: YK
Analysis and interpretation: YS, YK
Data collection: YS, YK, DS, JK, BK, DC, MH, YJ
Writing the article: YS, YK
Critical revision of the article: YS, YK, DS, JK, BK, DC, MH, YJ
Final approval of the article: YS, YK, DS, JK, BK, DC, MH, YJ
Statistical analysis: YS, YK
Obtained funding: YK
Overall responsibility: YK

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