Role of CT Images in the Endovascular Treatment of Iliac Artery Disease

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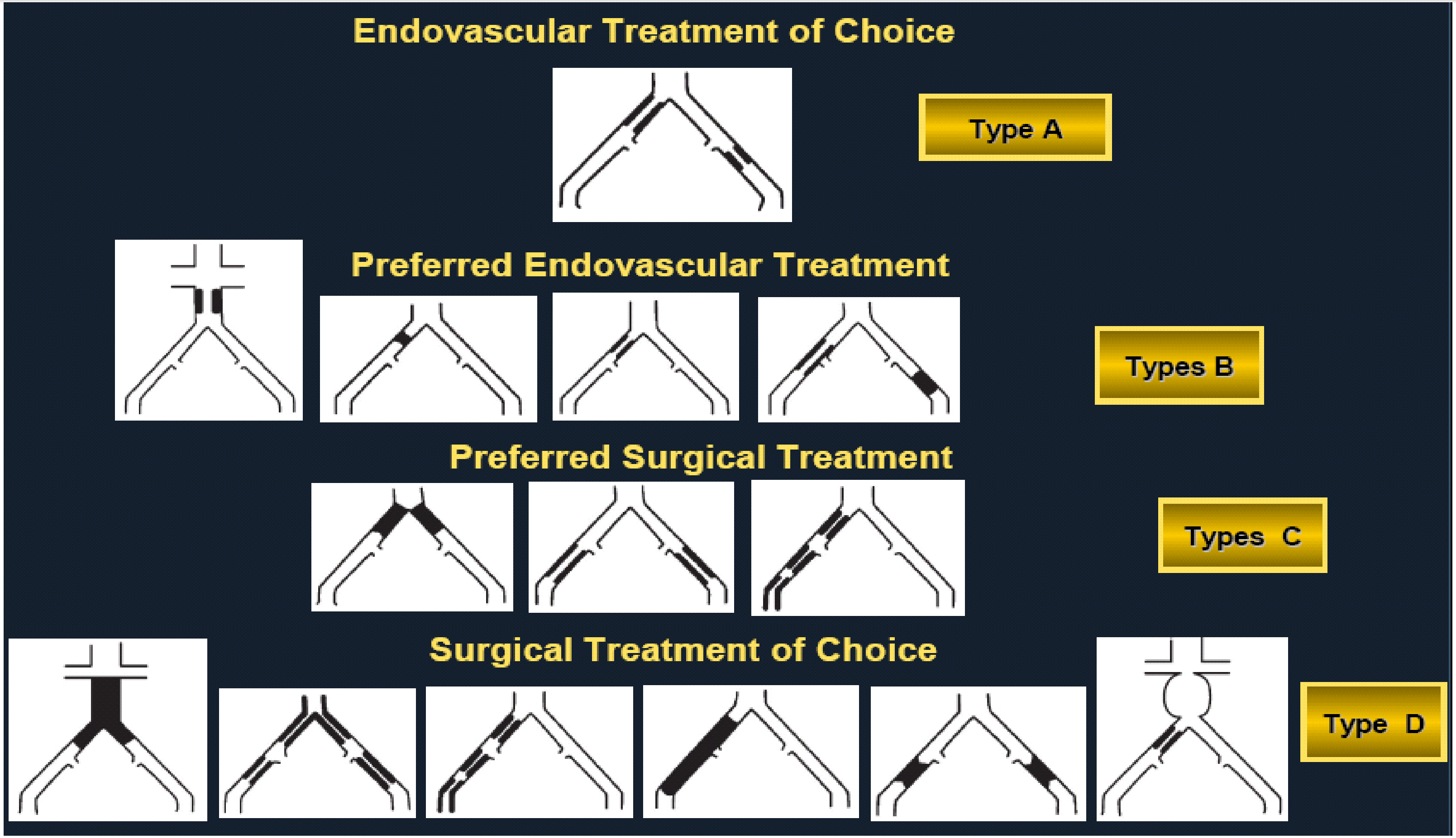
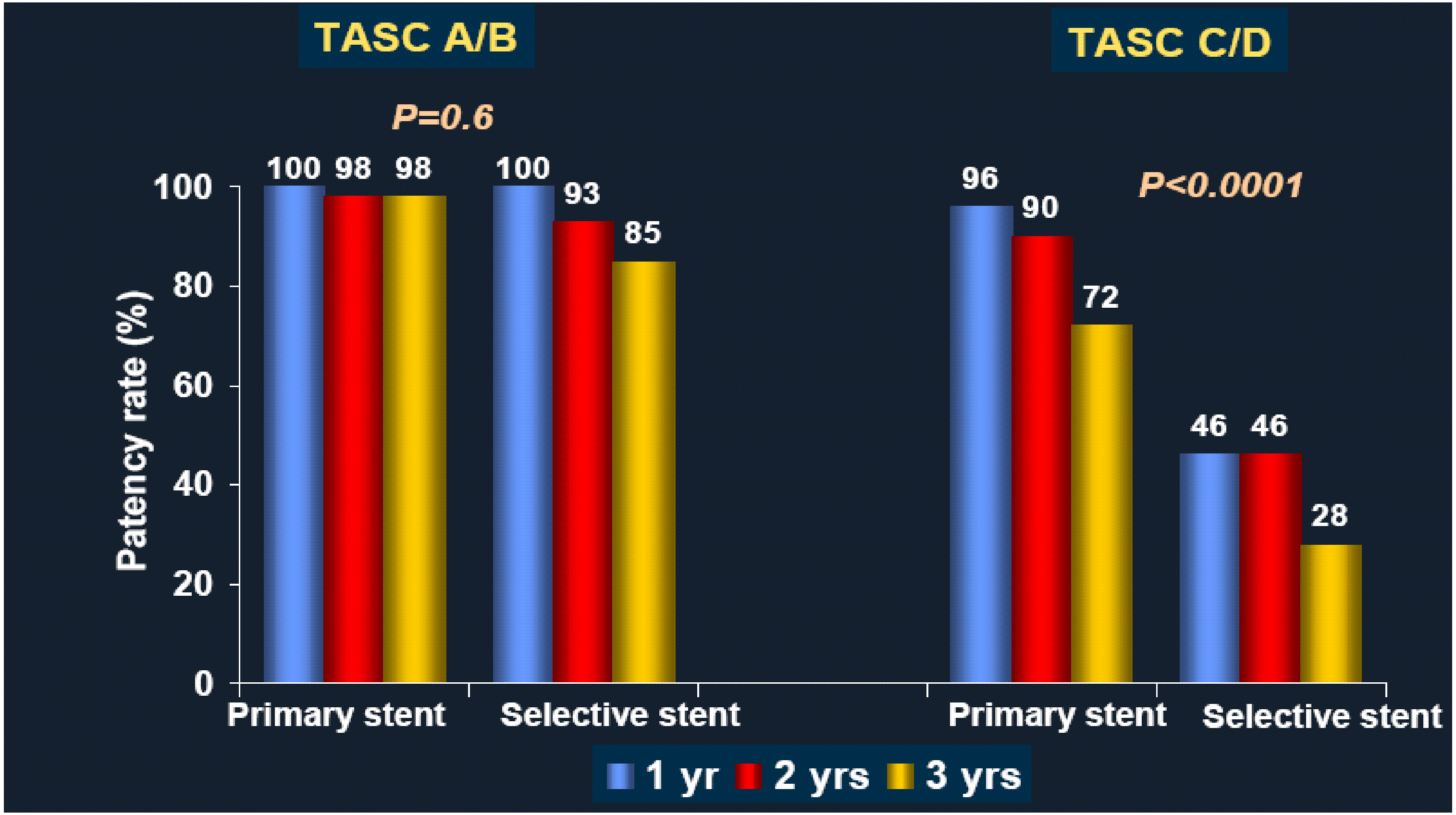
TASC II Classification of Iliac Artery Disease

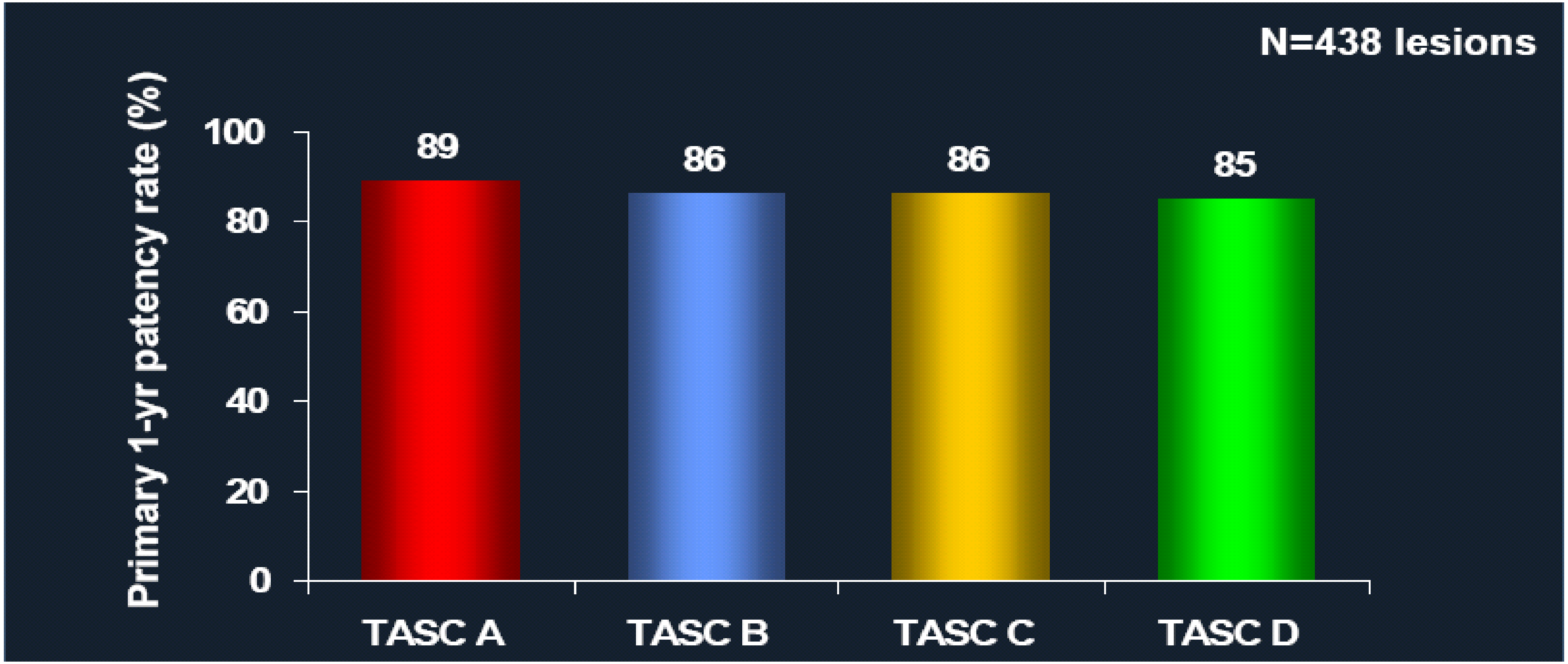


Primary Iliac Stenting vs. Provisional Stenting



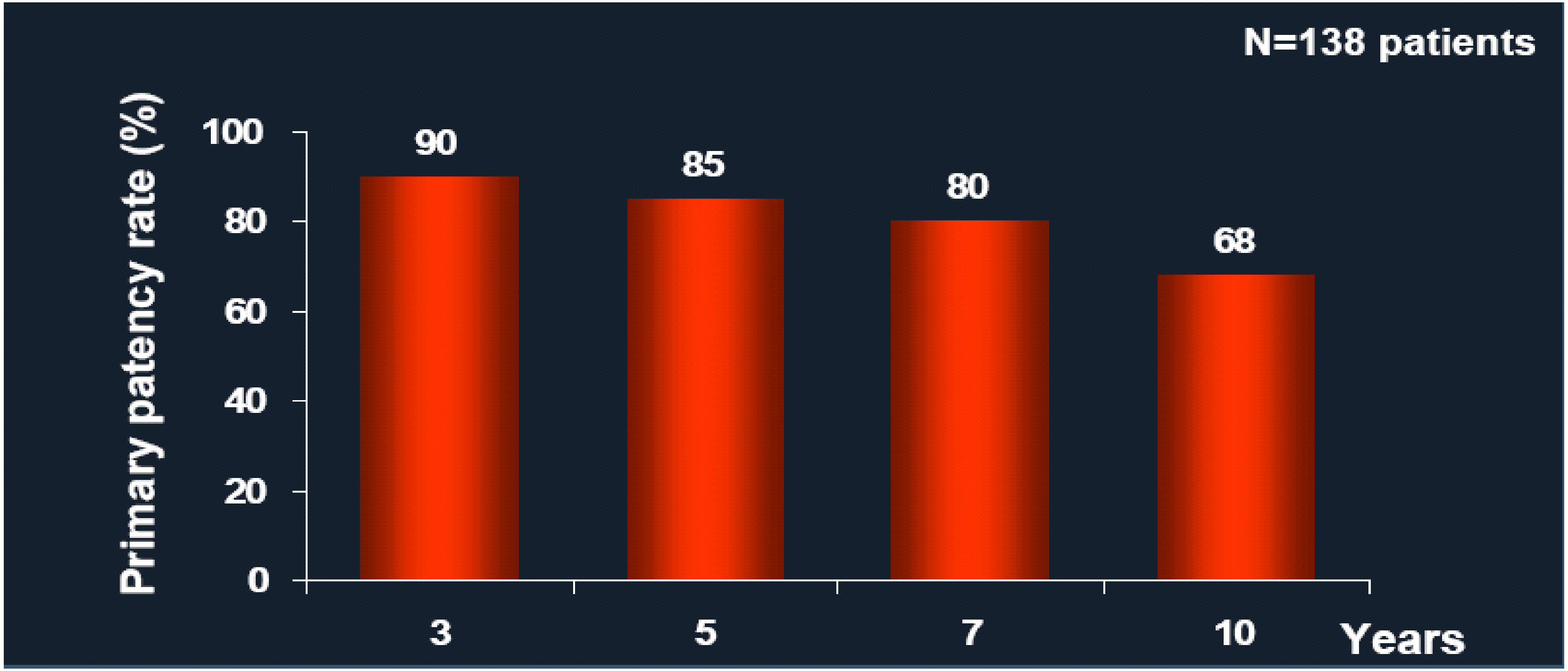
AbuRahma AF, J Vasc Surg 2007;46:965

Endovascular Therapy for Aortoiliac Lesions



Sixt S, J Endovasc Ther 2008;15:408

Percutaneous Treatment in Iliac Artery Occlusion: Long-term Results



Gandini R, Cardiovasc Intervent Radiol 2008;31:1069

ESC guidelines on PAD

- Recommendations for revascularization in patients with aortoiliac lesions

Recommendations	Class[a]	Level[b]
When revascularization is indicated, an endovascular-first strategy is recommended in all aortoiliac TASC A–C lesions.	I	C
A primary endovascular approach may be considered in aortoiliac TASC D lesions in patients with severe comorbidities, if done by an experienced team.	IIb	C
Primary stent implantation rather than provisional stenting may be considered for aortoiliac lesions.	IIb	C

Eur Heart J 2011

Complications of Iliac Interventions

According to a meta-analysis (n=1711)

- Mortality: 1.2~6.7%
- Morbidity: 3~45%

  - Access hematoma (4~17%)
  - Arterial dissections (1~11%)
  - Distal embolization (2~5%)
  - Pseudoaneurysms (0.5~3%)
  - Artery rupture (0.5~3%)

Jongkind V, J Vasc Surg 2010;52:1376

Perioperative Complications After Aorto-iliac Stenting

Perioperative Complications After Aorto-iliac Stenting: Associated Factors and Impact on Follow-up Cardiovascular Prognosis

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WHAT THIS PAPER ADDS

Because of acceptable durability, low operative mortality, device improvement, and increased operator experience, stent-supported endovascular therapy is widely used and considered first-line therapy for patients with aorto-iliac occlusive disease in clinical practice. In light of the association between perioperative complications (POC) occurrence and clinical outcomes documented in this study, stratification based on number of risk factors for POC occurrence plays an important role in decision making in this therapeutic modality.

Objectives: To investigate factors associated with 30-day perioperative complications (POC) after aorto-iliac (AI) stenting, and to compare follow-up cardiovascular prognosis between patients with and without POC.

Materials and methods: This was a retrospective multicenter study. We used a multicenter database of 2012 consecutive patients who successfully underwent AI stenting for peripheral arterial disease in 18 centers in Japan from January 2005 to December 2009 to analyze independent predictors of POC and impact of POC on prognosis by logistic regression and a Cox proportional hazard regression model, respectively.

Results: Mean age was 71 ± 9 years (median: 72 years; range: 37–98 years), and 1,636 patients (81%) were men. POC occurred in 126 patients (6.3%). In multivariate logistic regression analysis, old age (≥80 years), critical limb ischemia (CLI), and Trans Atlantic Inter-Societal Consensus (TASC) II class C/D were independently associated with POC with adjusted odds ratios and 95% confidence intervals (CI) of 1.9 (1.3–2.9), 2.3 (1.5–3.4), and 2.4 (1.6–3.4), respectively. Out of 2012 patients, 1995 were followed up for more than 30 days (mean: 2.6 ± 1.5 years; range: 2–2,393 days). In a Cox hazard regression model adjusted for baseline clinical characteristics, POC was positively and independently associated with follow-up major adverse cardiac events (adjusted hazard ratio [HR]: 1.9; 95% CI: 1.3–2.8; $p = .002$), but not with major adverse limb events and target lesion revascularization (adjusted HR: 1.4; 95% CI: 0.7–2.7; $p = .25$; and adjusted HR: 1.2; 95% CI 0.6–2.6; $p = .568$), respectively.

Perioperative complications at 30 days

Variables %, *n*	6.3 (126/2012)
Death	0.3 (7)
Myocardial infarction	0.2 (3)
Stroke	0.4 (7)
Worsening of renal function	0.9 (17)
Intestinal bleeding	0.2 (4)
Stent thrombosis	0.3 (6)
Pseudoaneurysm	0.3 (6)
Vessel perforation	0.2 (4)
Distal embolization	1.6 (32)
Puncture site hematoma	1.6 (33)
Others	0.3 (7)

Iida O, Eur J Vasc Endovasc 2014;47:131

Predictors of Perioperative Complications

	Univariate model Unadjusted OR (95% CI)	Multivariate model 1 Adjusted OR (95% CI)	Multivariate model 2 Adjusted OR (95% CI)
Age > 80 y	2.2 (1.5, 3.3)**	1.9 (1.3, 2.9)**	1.9 (1.3, 2.9)**
Male gender	0.8 (0.5, 1.3)	—	—
BMI < 18.5 kg/m^2	1.2 (0.7, 2.0)	—	—
Diabetes mellitus	1.2 (0.8, 1.7)	—	—
Hypertension	1.0 (0.6, 1.6)	—	—
Hyperlipidemia	0.8 (0.5, 1.1)	—	—
Regular dialysis	1.1 (0.7, 1.7)	—	—
Cardiovascular disease	1.2 (0.8, 1.7)	—	—
Critical limb ischemia	2.8 (1.9, 4.2)**	2.0 (1.3, 3.2)**	2.3 (1.5, 3.4)**
TASC C or D	2.7 (1.9, 3.9)**	2.4 (1.6, 3.4)**	2.4 (1.6, 3.4)**
Femoral lesion	1.6 (1.1, 2.3)*	1.1 (0.8, 1.7)	—
Below the knee lesion	1.9 (1.2, 3.1)**	1.3 (0.7, 2.2)	—

Iida O, Eur J Vasc Endovasc 2014;47:131

Subintimal Angioplasty for Iliac CTO

Efficacy of stent-supported subintimal angioplasty in the treatment of long iliac artery occlusions

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Background: **Subintimal angioplasty (SA) is becoming increasingly accepted as a revascularization technique for chronic arterial occlusive disease. However, its efficacy in iliac artery occlusions has not been established. Therefore, we investigated the procedural and clinical outcomes of subintimal angioplasty in long iliac artery occlusions and compared them with those of intraluminal angioplasty (IA) in nonocclusive stenotic iliac artery lesions.**
Methods: **We retrospectively analyzed data from 151 consecutive patients with long (>5 cm) iliac artery lesions (204 limbs) who underwent angioplasty with primary stent implantation from October 2004 through July 2008. Among them, 100 lesions in 100 patients were treated with intentional SA, and 104 lesions in 82 patients were treated with IA. We compared the baseline characteristics and immediate and long-term outcomes of iliac artery lesions treated with SA versus IA.**
Results: **Baseline characteristics showed that longer lesions and critical limb ischemia were found more frequently in the SA group, whereas diabetes and combined femoropopliteal lesions were present more often in the IA group. The technical success rate of SA was lower than that of IA (93.0% vs 99.0%; $P = .048$). However, there was no significant difference in the procedure-related complications between the SA and IA groups (4.0% vs 4.8%; $P = .779$). Primary patency rates for SA and IA were 96.8% and 98.0% at 1 year, and 93.9% and 90.6% at 2 years, respectively (log rank $P = .656$).**
Conclusion: **Stent-supported SA in occlusive iliac lesions was safe and showed a high long-term patency rate comparable to that of IA performed in nonocclusive iliac lesions despite longer lesion length. Thus, SA with implantation of stents is an effective technique for the treatment of chronic long iliac artery occlusion. (J Vasc Surg 2011;54:116-22.)**

For complex, multifocal, or long stenotic or occlusive lesions of iliac arteries, surgery has been the standard treatment.[1,2] However, endovascular therapy is a less invasive procedure that has shown improved clinical outcomes in iliac lesions due to recent advances in devices and skills.[2,3] Recent studies using stents in iliac arteries reported high technical success, good mid- and long-term patency, and low procedural morbidity and mortality.[4-7] This led to the removal of the length restriction on common iliac artery stenoses and the inclusion of more complex iliac artery lesions in the definitions of type A and B lesions in the updated TransAtlantic Inter-Societal Consensus (TASC) II guidelines, for which endovascular therapy is more preferentially recommended.[2,3] However, extensive iliac occlusions involving external iliac arteries still belong to type C and D lesions, for which surgical treatment is considered the primary therapy.

From the Division of Cardiology, Severance Cardiovascular Hospital, Yonsei University Health System.

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Competition of interest: none.

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In the treatment of occlusive lesions with endovascular therapy, there are two technical methods to cross the occlusion with a wire, either by an intraluminal or subintimal approach. Intentional subintimal angioplasty (SA), which was first described by Bolia et al[8] in 1989, offers some theoretic advantages over conventional angioplasty. This technique is based on the intentional creation of an extraluminal channel between the intimal and medial layers or within the medial layer of the arterial wall, displacing the true lumen filled with atherothrombotic materials to one side of the vessel wall. SA has been primarily used for recanalizing long femoropopliteal or tibial occlusions with relatively high technical success rates; however, only a few studies have described the outcomes of SA in iliac lesions.[9-12] Thus, the aim of this study was to investigate the procedural and clinical outcomes of SA in long occlusive lesions of iliac arteries and compare them with those of intraluminal angioplasty (IA) in nonocclusive long lesions of iliac arteries.

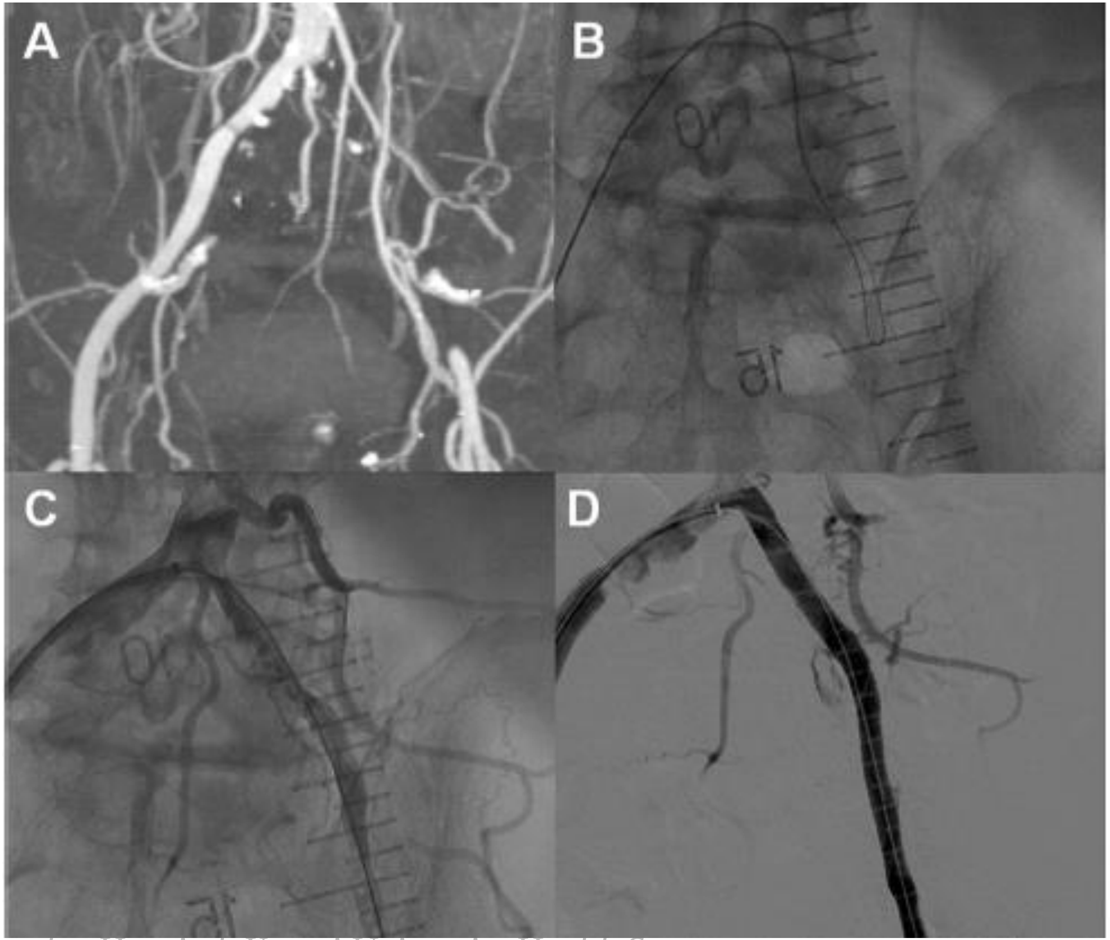
MATERIALS AND METHODS

Patient population. Between January 2004 and December 2008, stent-supported endovascular treatment was performed in 344 iliac arteries of 266 consecutive patients (228 men; mean age, 65.1 ± 9.2 years). Among them, we identified 151 patients (204 limbs) with long (>5 cm) iliac artery stenotic or occlusive lesions who were treated with percutaneous angioplasty (percutaneous transluminal angioplasty [PTA]) and primary stenting. Sixty-nine patients (100 limbs) with iliac artery occlusions (diameter stenosis 100 ± 0%, lesion length 97 ± 35.9 mm) were treated with intentional SA. Conventional IA was performed in 82 patients (104

Subintimal angioplasty for CTO
(100 limbs)
Vs.
Intraluminal angioplasty
for stenotic lesions (104 limbs)

J Vasc Surg 2011;54:116

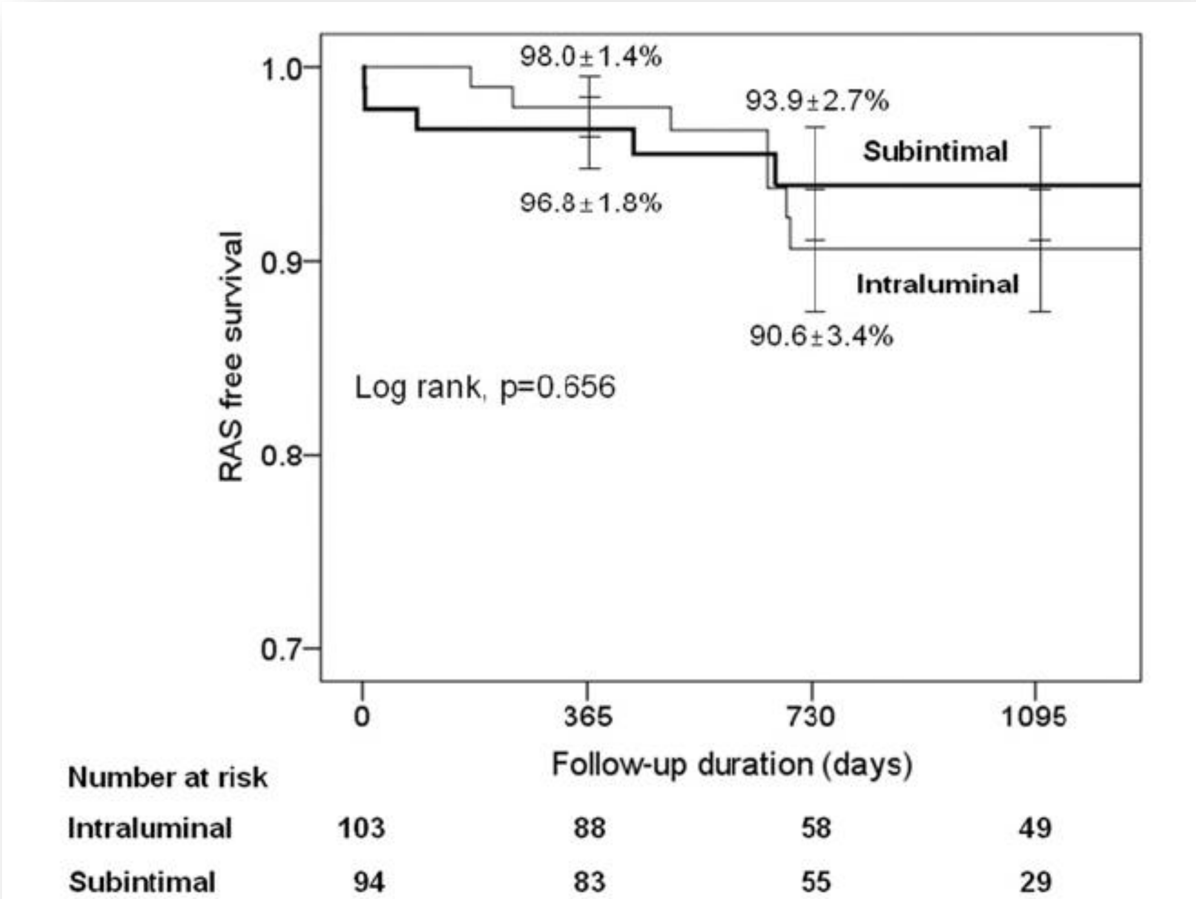
Subintimal Angioplasty



Procedural Data

Variable	*Intraluminal angioplasty (n = 104)*	*Subintimal angioplasty (n = 100)*	P *value*
Lesion type (TASC II) (n [%])			<.001
Type B	34 (32.7%)	0 (0.0%)	
Type C	53 (51.0%)	15 (15.0%)	
Type D	17 (16.3%)	85 (85.0%)	
Location of the lesion (n [%])			.006
CIA only	34 (32.7%)	29 (29.0%)	
EIA only	37 (35.6%)	19 (19.0%)	
CIA and EIA	33 (33.0%)	52 (52.0%)	
Diameter stenosis (%)	80.3 ± 10.2	100 ± 0	<.001
Lesion length (mm)	62.0 ± 24.2	97 ± 35.9	<.001
Technical success (n [%])	103 (99.0%)	94 (94.0%)	.048
Number of used stents	1.2 ± 0.4	1.6 ± 0.6	<.001
Balloon-expandable stents	0.3 ± 0.5	0.4 ± 0.5	.038
Self-expandable stents	1.0 ± 0.5	1.1 ± 0.8	.089
Stent diameter (mm), (ranges, mm)	8.5 ± 1.2 (6-14)	8.6 ± 1.3 (7-14)	.441
Stent length (mm), (ranges, mm)	77.5 ± 30.5 (39-180)	94.6 ± 33.1 (37-160)	<.001
Combined treatment (n [%])			
Common femoral artery lesions (n [%])	14 (13.5%)	24 (24.0%)	.053
Femoropopliteal lesions (n [%])	33 (31.7%)	28 (28.0%)	.561
Infrapopliteal lesions (n [%])	4 (3.8%)	2 (2.0%)	.443
Contralateral iliac lesions (n [%])	63 (60.6%)	53 (53.0%)	.275
By intraluminal angioplasty (n [%])	50 (48.1%)	14 (14.0%)	
By subintimal angioplasty (n [%])	13 (12.5%)	39 (39.0%)	
Procedure-related complications (n [%])	5 (4.8%)	4 (4.0%)	.779
Major complications (n [%])	2 (1.9%)	1 (1%)	.999
Rupture (n [%])	1 (1.0%)	0 (0.0%)	.326
Distal embolization (n [%])	4 (3.8%)	4 (4.0%)	.955
Death (n [%])	0 (0.0%)	0 (0.0%)	>.999
Ankle-brachial index			
Pre	0.55 ± 0.23	0.41 ± 0.23	.001
Post	0.88 ± 0.23	0.86 ± 0.25	.611
Thigh-brachial index			
Pre	0.66 ± 0.25	0.48 ± 0.21	<.001
Post	0.96 ± 0.20	0.98 ± 0.19	.595

Primary Patency



Procedure Planning using CT

- **Lesion location:**

  - decision for approach
- **Lesion anatomy:**

  - diffuse or focal,

  - calcification

  - tortuosity

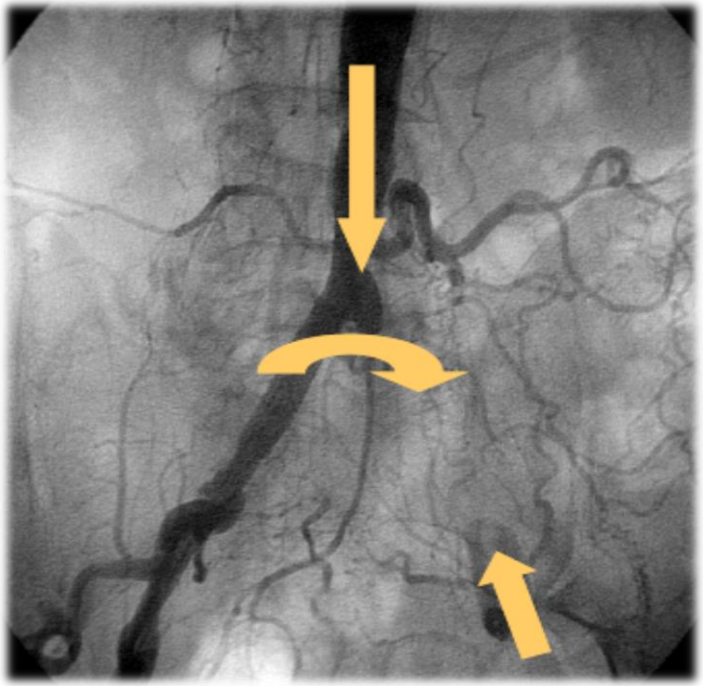
  - vessel & lumen diameter

  - thrombus?

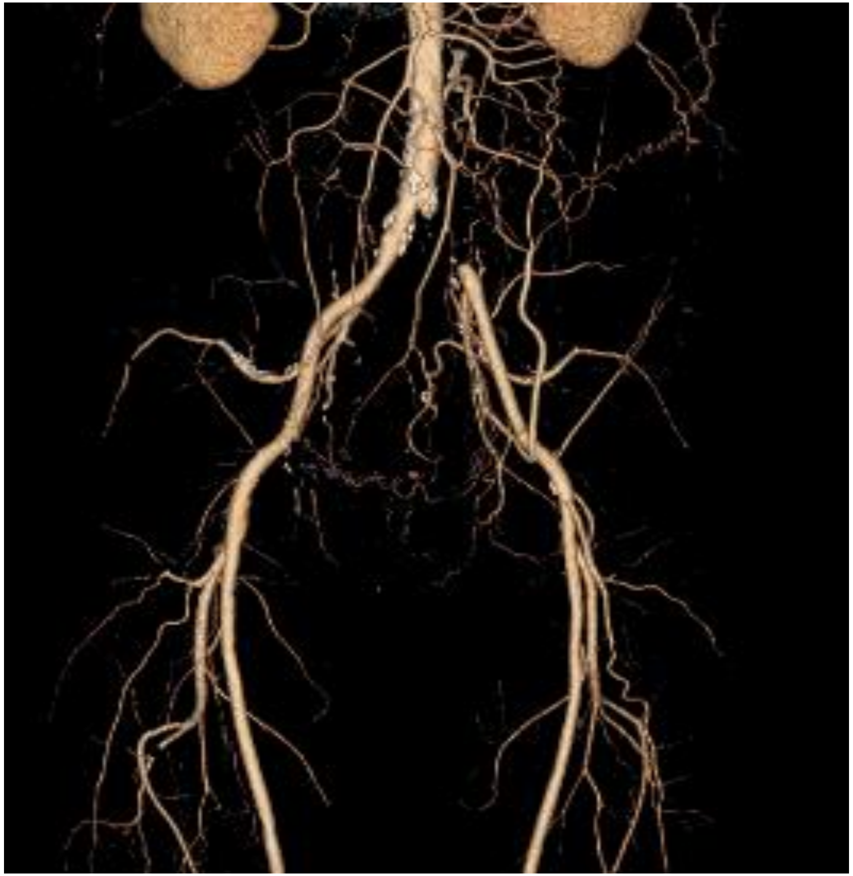
Access to the Target Lesion

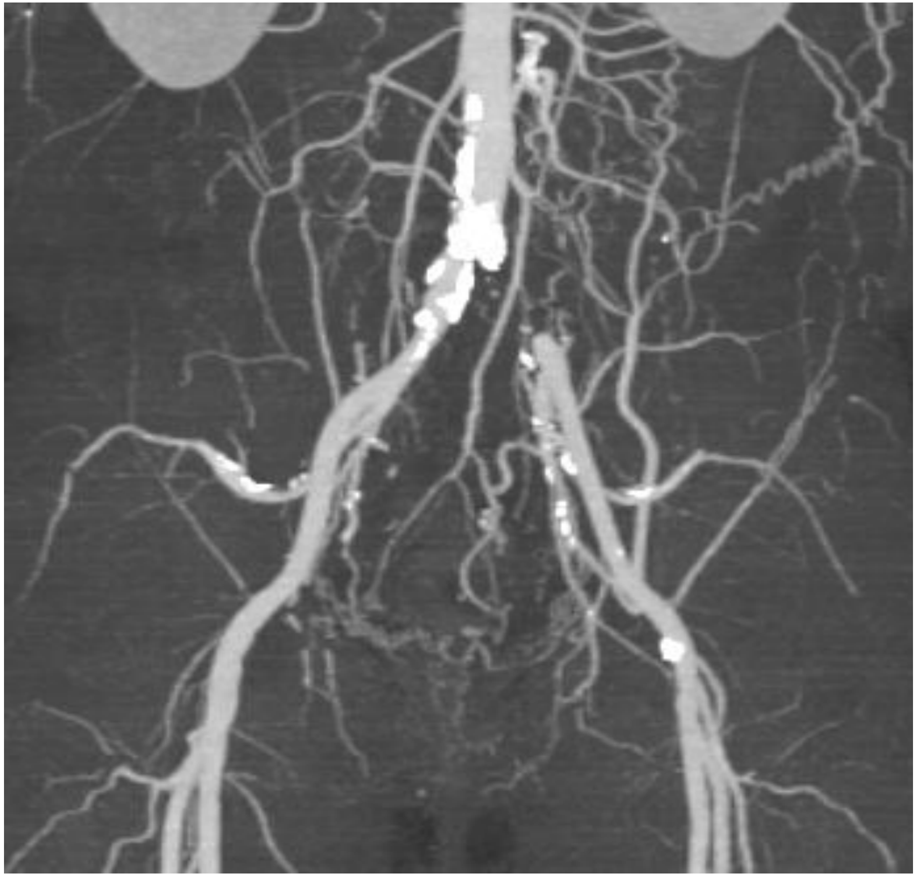
- **Ipsilateral retrograde approach**
- **Contralateral antegrade approach (Cross-over technique)**
- **Brachial approach**

Choose access site according to the location & extent of the lesion



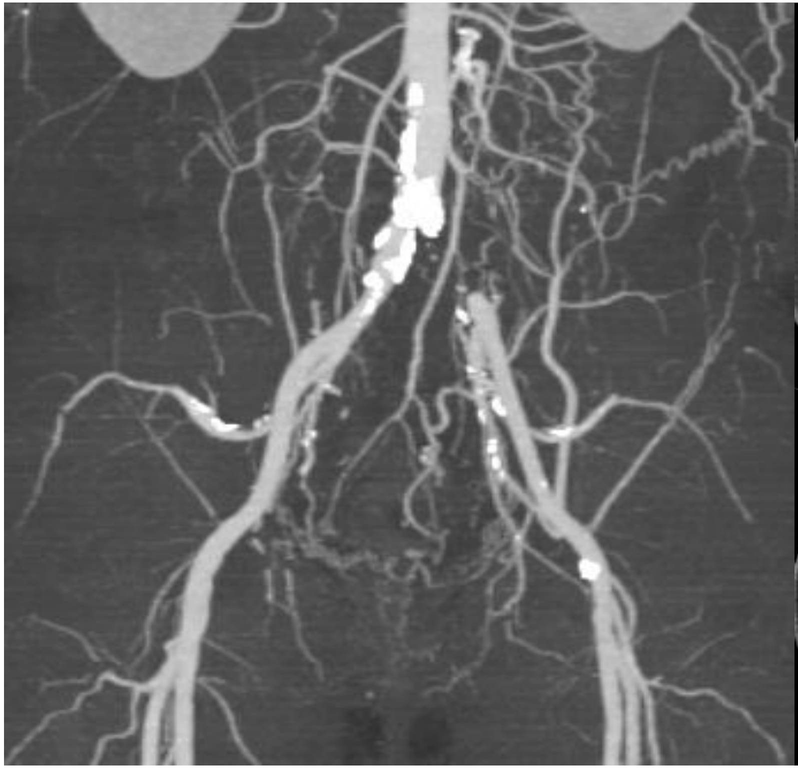
M/48 (LKS, #7512524)

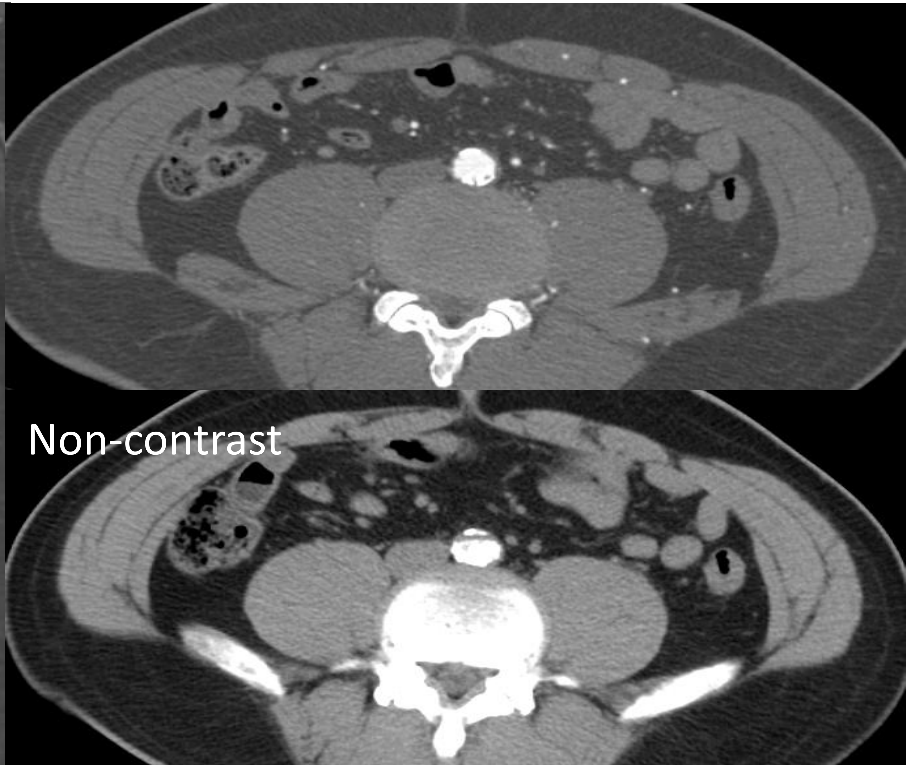




Calcification

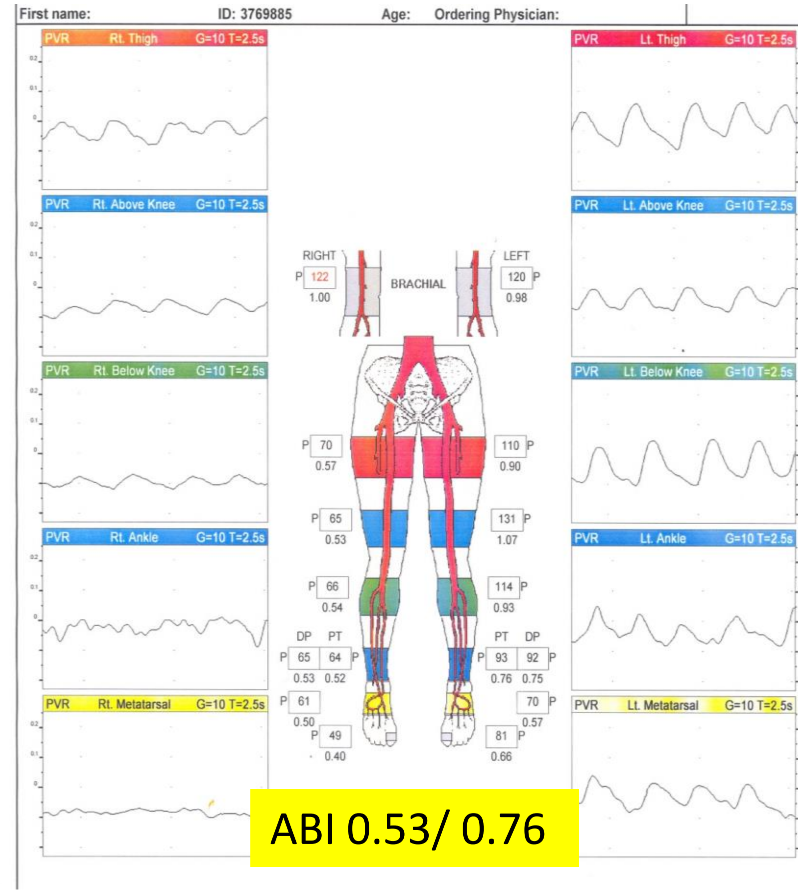
LKS #7512524





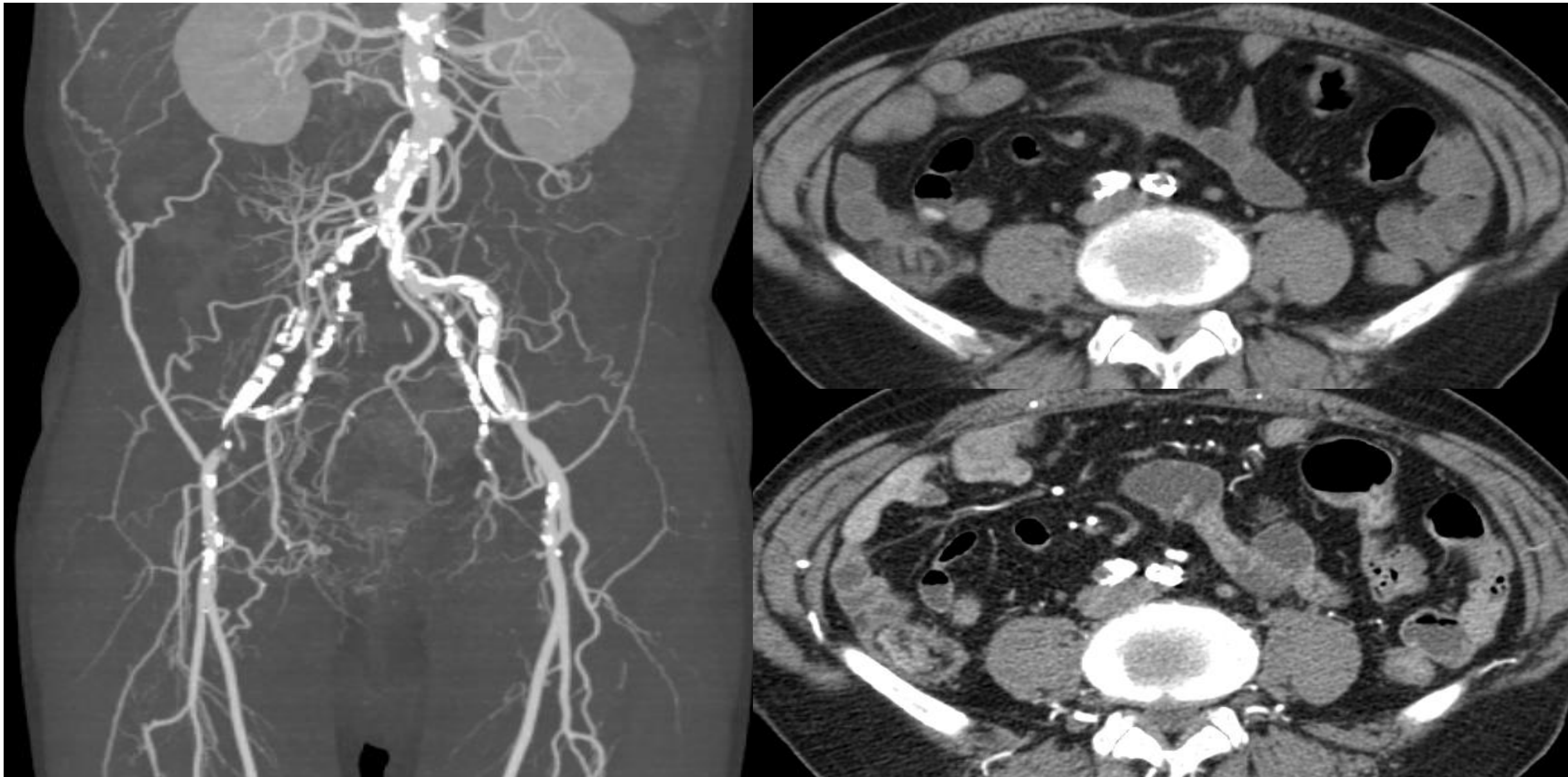
M/62 (OJS #3769885)

- CC:
  Rt. leg
  claudication
  at 100M
- Risk factors:
  - HTN, smoking
- PHx:
- -A-fib/flutter



ABI 0.53/ 0.76

M/62 (OJS #3769885)



F/45 (BSN, #7520730)

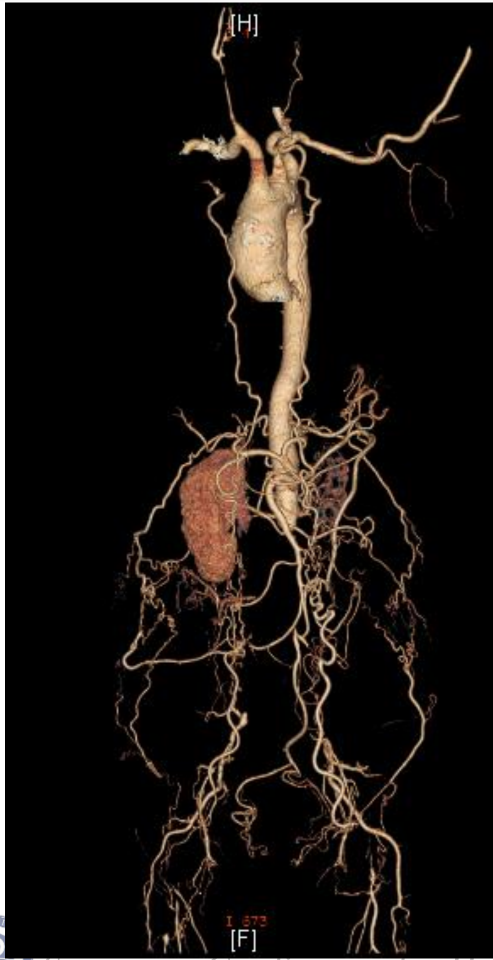
- CC: Both leg claudication at 50M
- PHx: HTN, CRF

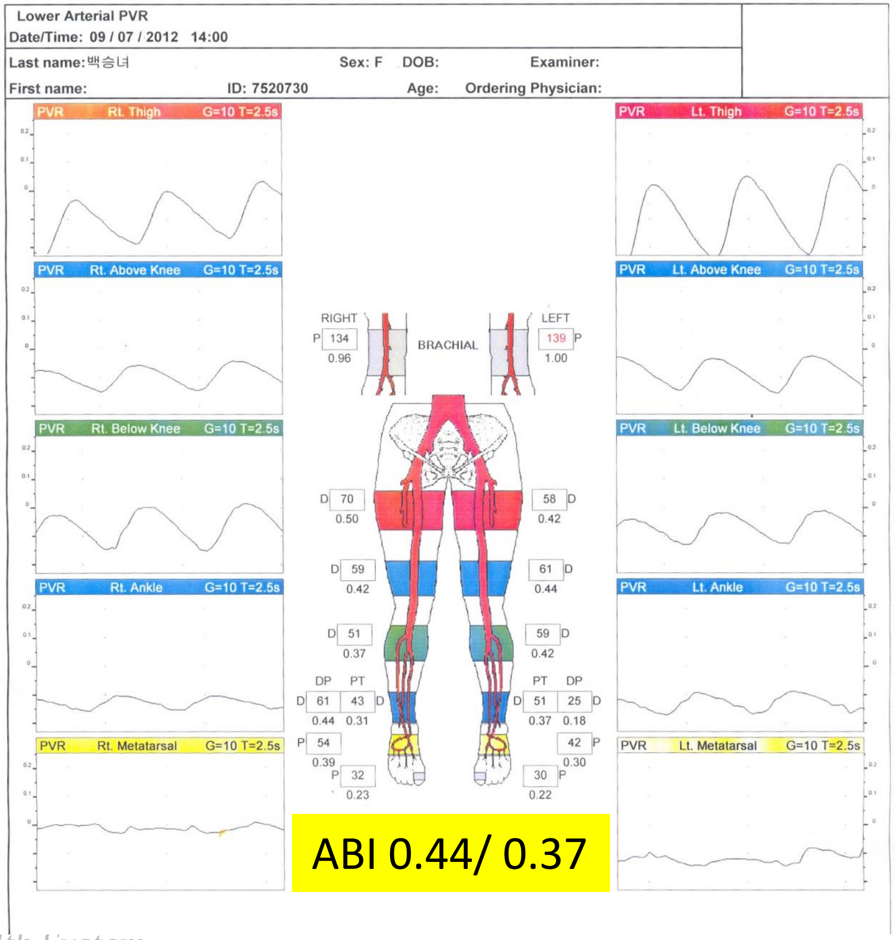
  Renal infarction

  Multiple aborted pregnancy
- Lab: Cr 1.74 mg/dL, ESR 24 mm

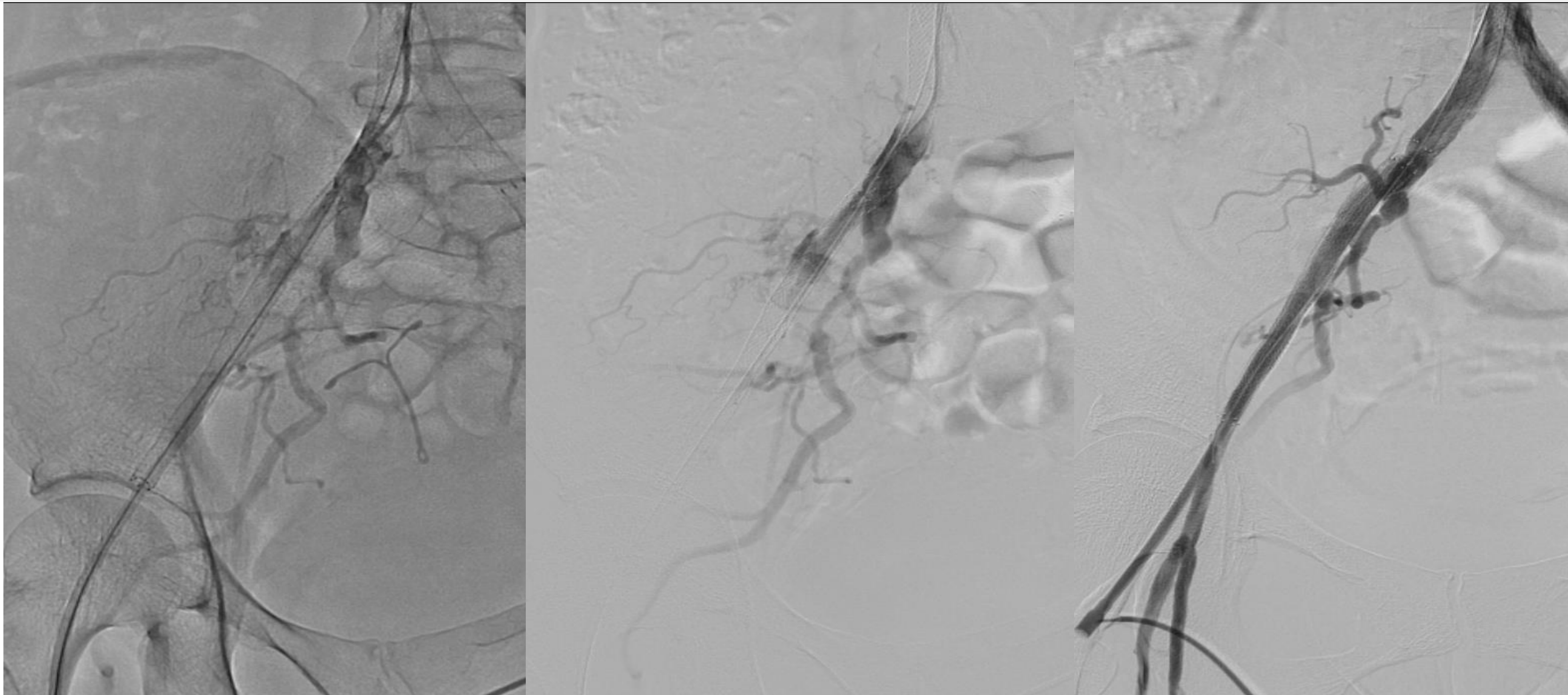
  Lupus anticoagulant +

F/45 (BSN, #7520730)





ABI 0.44/ 0.37



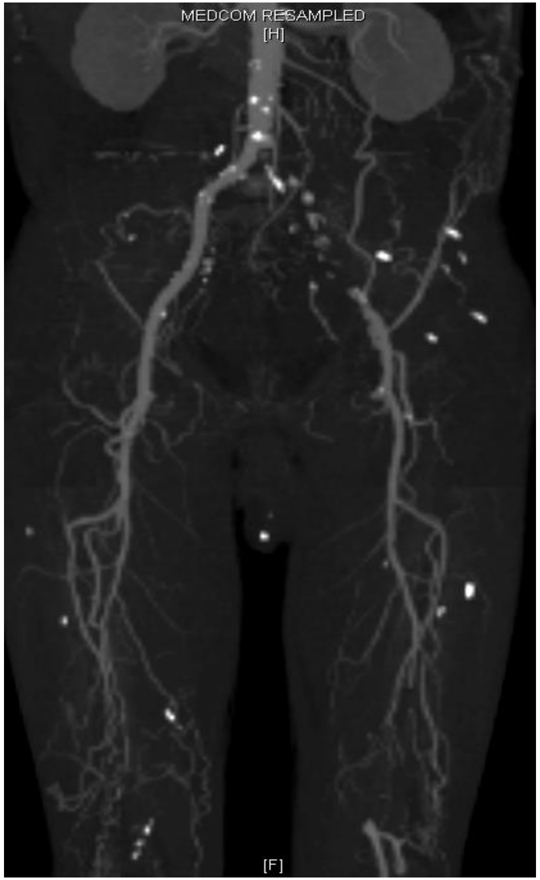
M/64 (LKJ, #2450191)

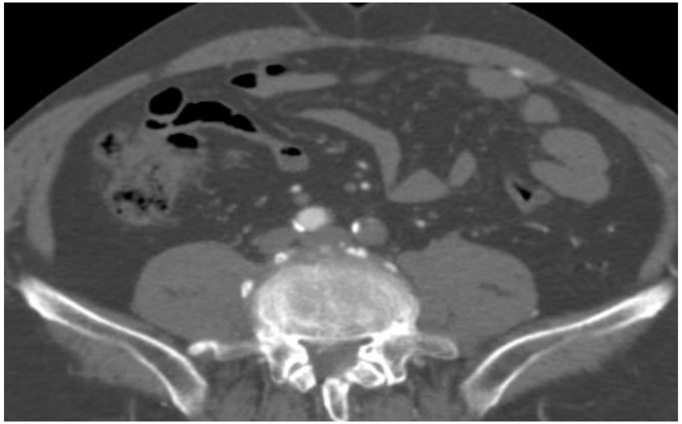
- CC: Lt. leg claudication

  at 200M

- Risk factors: Smoking
- PHx: HTN

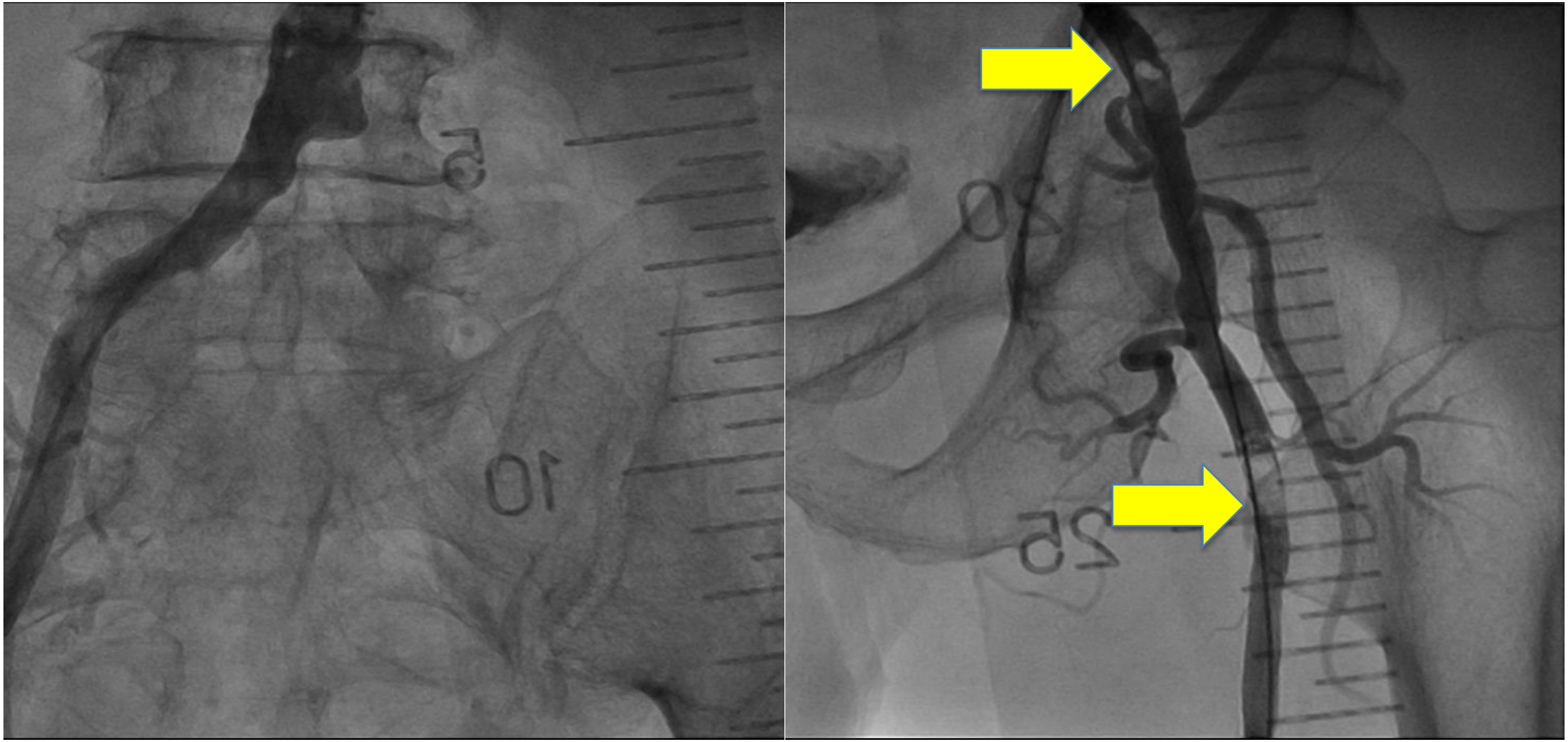
  CAD (1-VD)





ABI 0.68/ 0.57

Distal embolism



Severance Hospital Data: Immediate Procedure Results

Retrospective cohort: 254 patients (342 limbs) with pre-procedural CT images

Immediate results	Lesions (n=342)
Procedural success without any complications	314 (91.8%)
Procedure failure or complications	28 (8.2%)
Rupture	5 (1.5%)
Distal embolization	11 (3.2%)
No distal flow due to failure of SFA recanalization	4 (1.2%)
Failure of wire passage	8 (2.3%)

Baseline Clinical Data

	All n=342	Success n=314	Failure n=28	p-value
Age	68±9	68±9	65±11	0.177
Male	308 (90)	283 (90)	25 (89)	0.887
BMI	22.8±3.2	22.8±3.3	22.9±2.0	0.799
Hypertension	235 (69)	216 (69)	19 (68)	0.919
Diabetes	139 (41)	129 (41)	10 (36)	0.579
Dyslipidemia	161 (47)	146 (47)	15 (54)	0.472
Chronic kidney disease	62 (18)	57 (18)	5 (18)	0.969
End stage renal disease on dialysis	9 (3)	9 (3)	0	0.364
Critical limb ischemia	51 (15)	46 (15)	5 (18)	0.648
Degree of stenosis	89±14	88±14	97±8	<0.001
Lesion length	72±28	71±28	88±30	0.001
Chronic total occlusions	152 (45)	128 (41)	24 (86)	<0.001
Pre-procedural thigh brachial index	0.60±0.22	0.58±0.22	0.62±0.24	0.432
Pre-procedural ankle brachial index	0.68±0.22	0.67±0.22	0.68±0.18	0.982

CT Parameters

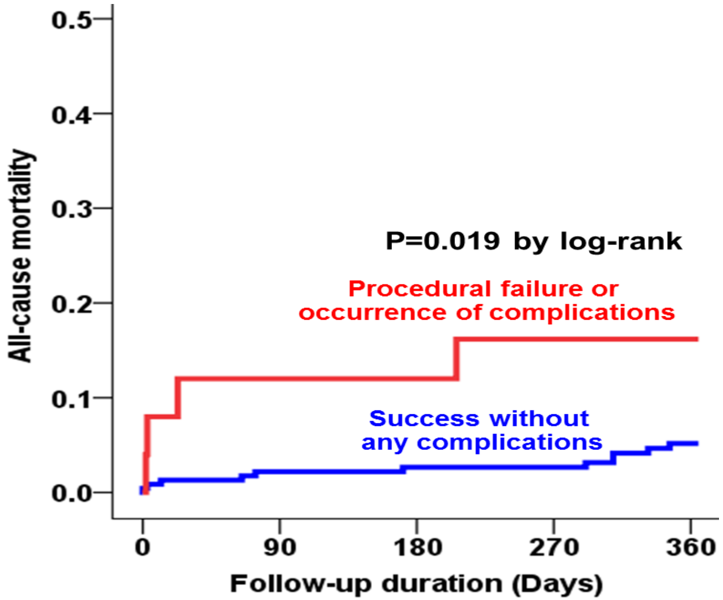
	All n=342	Success n=314	Failure n=28	p-value
CIA diameter (mm)	10.3±1.9	10.3±1.9	9.8±2.1	0.224
EIA diameter (mm)	6.9±1.4	7.0±1.3	6.0±2.1	0.020
CIA calcium arc (°)	171±110	172±108	152±132	0.437
EIA calcium arc (°)	86±102	85±100	99±117	0.499
CIA calcium maximal thickness (mm)	3.5±1.9	3.5±1.8	3.1±2.7	0.415
EIA calcium maximal thickness (mm)	1.5±1.6	1.5±1.6	1.6±1.5	0.620

Predictors of Procedure Failure or Complications

Variables	β	p-value
Total occlusion	5.75	0.003
EIA diameter (mm)	0.76	0.046
Lesion length	1.01	0.216

Mortality Risk

	All n=254	Success n=229	Failure n=25	p-value
In-hospital mortality	6 (2%)	3 (1%)	3 (12%)	0.008
All-cause mortality at 1 year	15 (6%)	11 (5%)	4 (16%)	0.019



Risk factors of 1-year Mortality

	Univariate		Multivariate	
	HR	p-value	HR	p-value
Age	1.074	0.030	1.053	0.151
Sex	0.449	0.215	-	
BMI	0.827	0.021	0.894	0.246
Critical limb ischemia	1.668	0.428	-	
Hypertension	1.281	0.672	-	
Diabetes	1.305	0.607	-	
Chronic kidney disease	1.116	0.865	-	
End stage renal disease on dialysis	6.528	0.014	10.599	0.004
Procedural failure or complication	3.592	0.029	4.440	0.015
Pre-procedural CT findings			-	
CIA diameter (mm)	1.093	0.484	-	
EIA diameter (mm)	1.103	0.596	-	
CIA calcium arc (degree)	1.004	0.082	1.001	0.736
EIA calcium arc (degree)	1.006	0.005	1.002	0.543
CIA calcium maximal thickness (mm)	1.162	0.191	-	
EIA calcium maximal thickness (mm)	1.404	0.004	1.255	0.278
Chronic total occlusions	1.178	0.752	-	
Lesion length	1.011	0.226	-	

Take Home Messages

- Procedural success without complications was achieved in most of patients with aortoiliac lesions.
- The incidence of procedural complications is relatively low. However, it is associated with increased risk of immediate and late mortality.
- A smaller diameter of EIA rather than the severity of calcification on pre-procedural CT was associated with failure or occurrence of complications.
- Therefore, meticulous review of CT images prior to intervention is important for safe and successful procedure.


Thank you
for your attention!