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Effect of Stenting on the Near-Infrared Spectroscopy-Derived Lipid Core Burden Index of Carotid Artery Plaque

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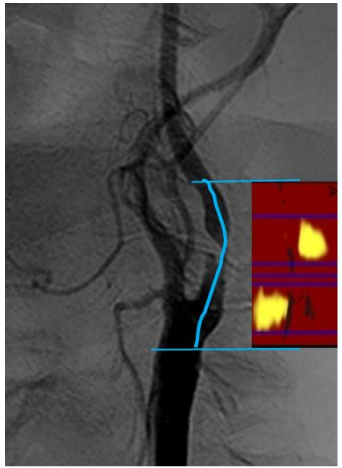
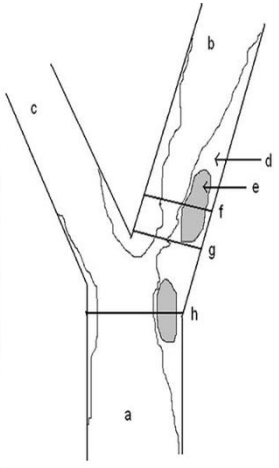
Introduction

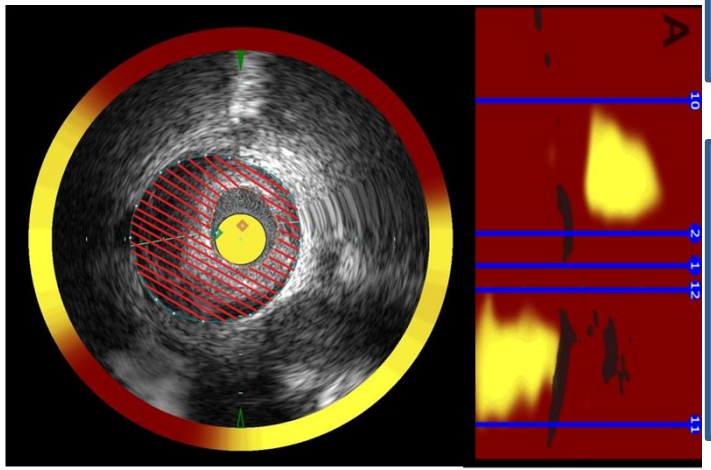
- ESC guidelines on the management of an asymptomatic carotid stenosis emphasize severity of stenosis but angiographic degree of stenosis is only a poor predictor of stroke.
- Plaque composition, not stenosis, might be an important determinant of stroke. Some high risk plaque features have been recognized in the updated ESC guidelines in 2017.
- The aim of the study was to describe the effect of carotid artery stenting (CAS) on the lipid signal in a carotid stenosis.
- The response of the lipid signal was assessed with intravascular NIRS-derived lipid core burden index (LCBI) in a segment of common and internal carotid artery before and after stent implantation.

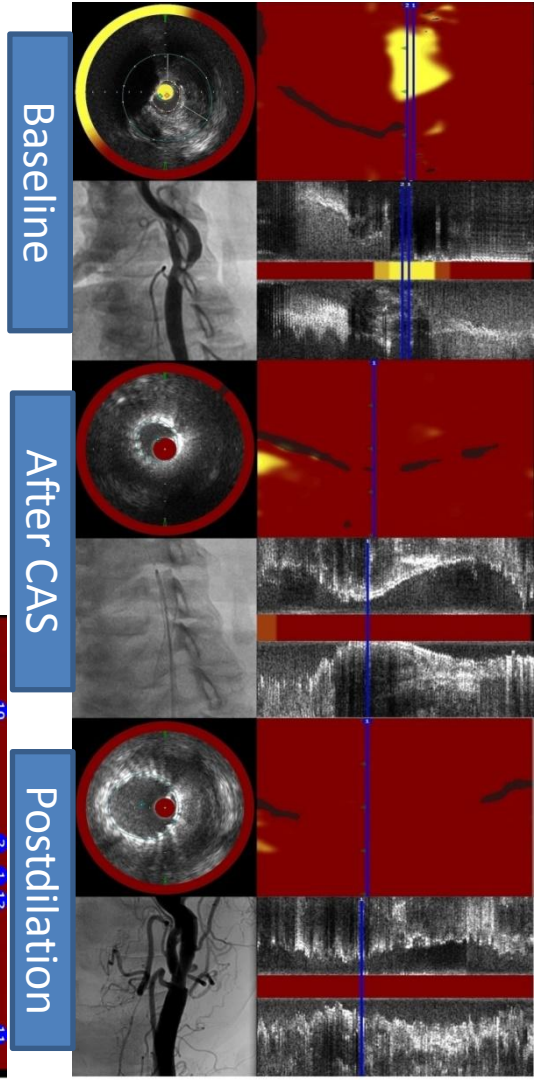
Methods

- Automated NIRS-IVUS pullback through 40mm segment, speed 0,5 mm/s, 40 spectroscopic measurements per second. Every measurement is binary coded (1/0) as yellow or red pixel. A spectroscopic map = chemogram.
- Lipid core burden index (LCBI, unitless number from 0 to 1000) is a fraction of yellow pixels on the chemogram x 1000.









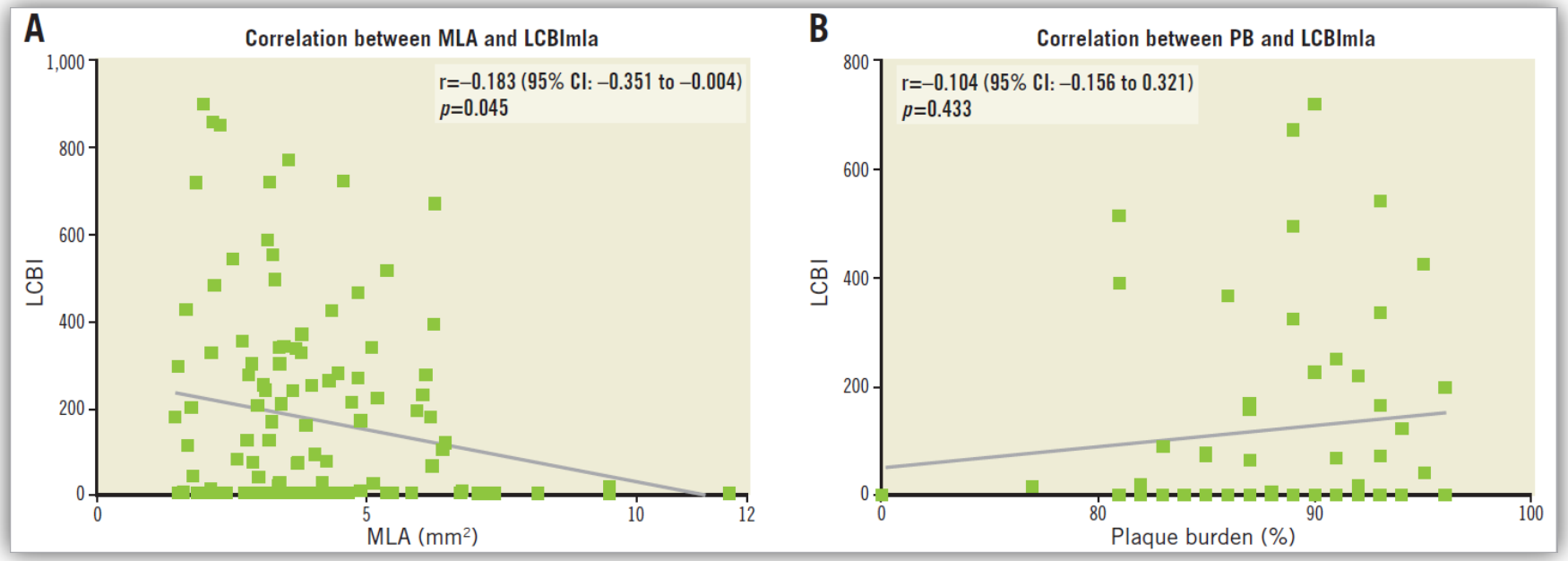
Results

Table 1. Study population.	N=120 (%)
Male	75 (67%)
Age (years)	67.4 ± 8.1
Body mass index (kg/m2)	28.0 ± 4.0
Symptomatic stenosis	17 (14%)
Coronary artery disease	60 (50%)
Diabetes	44 (37%)
Arterial hypertension	104 (87%)
Smoking	49 (41%)
High risk patient*	78 (65%)
Medication	
Statin	92 (77%)
Aspirin	101 (84%)
Beta-blocker	66 (55%)
RAAS inhibitor	89 (74%)

*One of the following: Left ventricle ejection fraction ≤ 40%, chronic bronchopulmonary disease, prior myocardial infarction, coronary (>2) bypass grafts or age ≥ 75 years.

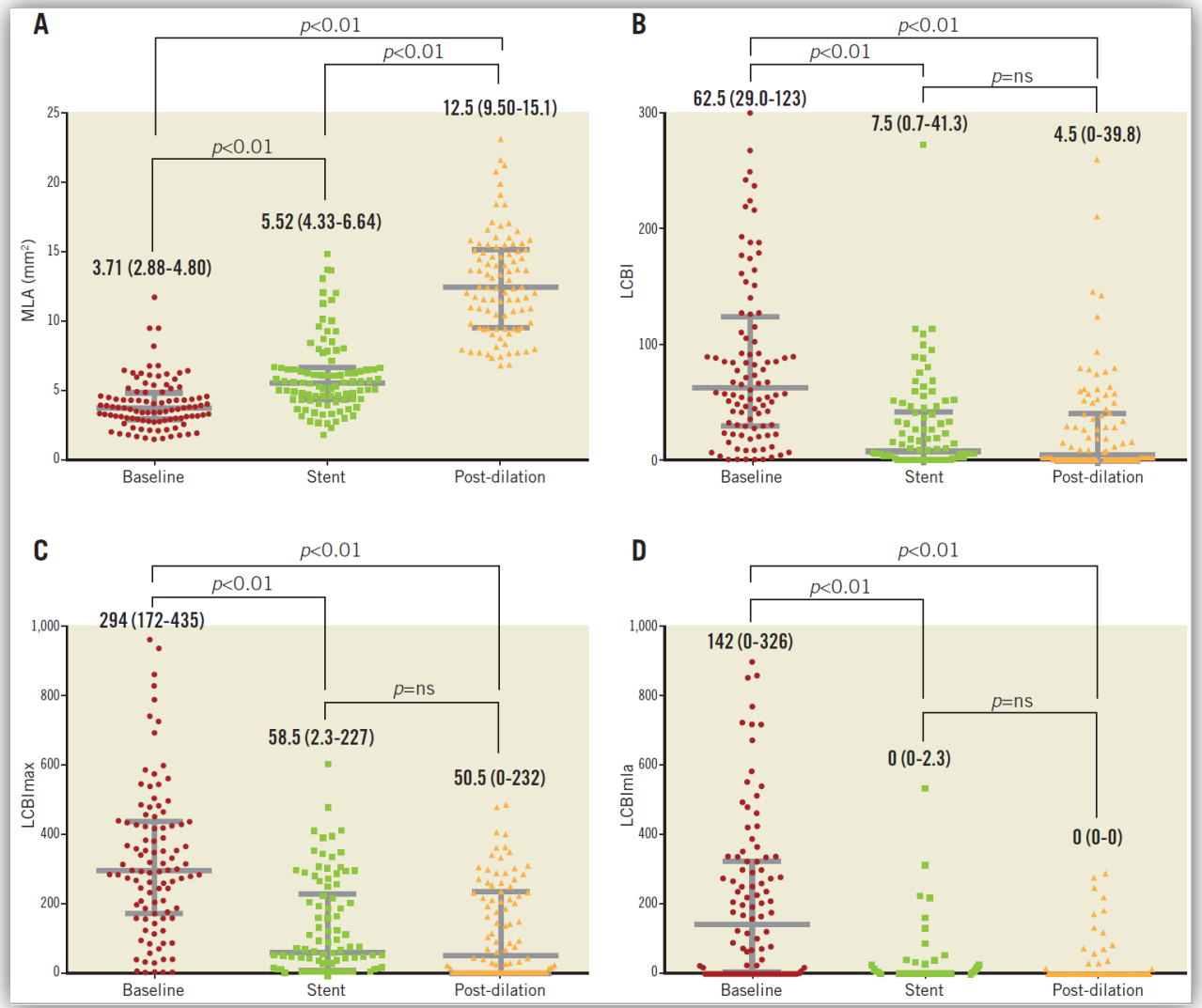
Table 2. Procedural characteristics.	
Left carotid as a target vessel	67 (56%)
Diameter stenosis at angiography (%)	84 ± 9
Residual stenosis at angiography after CAS (%)	8 ± 8
Use of protection device	100 (100%)
Proximal occlusion device*	16 (13%)
Distal filter device*	113 (94%)
Direct stenting	110 (92%)
Postdilatation	117 (98%)
Stent type	
Open cell stent	33 (26%)
Hybrid stent	13 (10%)
Closed cell stent	83 (64%)
Stent length (mm)	37 ± 5
Fluoroscopy time (minutes)	8.0 ± 3.6

Results


A
Correlation between MLA and LCBImla
r=–0.183 (95% CI: –0.351 to –0.004)
p=0.045
LCBI
1,000
800
600
400
200
0
0
5
10
12
MLA (mm²)
B
Correlation between PB and LCBImla
r=–0.104 (95% CI: –0.156 to 0.321)
p=0.433
LCBI
800
600
400
200
0
0
80
90
100
Plaque burden (%)

Results

	n (%)	LCBI, median (IQR)	P value	LCBImax, median (IQR)	P value	LCBImla, median (IQR)	P value
Sex							
Male	75 (67%)	75 (30 - 152)	0,096	315 (173 - 467)	0,213	177 (0 - 347)	0,196
Female	37 (33%)	56 (21 - 84)		289 (151 - 362)		76 (0 - 241)	
Symptomatic stenosis							
Yes	17 (14%)	88 (56 - 179)	0,098	381 (271 – 543)	0,100	300 (0 – 495)	0,587
No	103 (86%)	57 (25 - 104)		291 (157 – 428)		122 (1 – 286)	
Coronary artery disease							
Yes	60 (50%)	56 (28 - 153)	0,825	293 (155 - 480)	0,938	120 (0 - 298)	0,949
No	60 (50%)	67 (31 - 102)		296 (203 - 426)		172 (0 - 338)	
Statin therapy at baseline							
Yes	92 (77%)	65 (29 - 126)	0,511	294 (174 - 449)	0,873	159 (0 - 337)	0,396
No	28 (23%)	67 (47 - 153)		314 (244 - 422)		41 (0 - 267)	


A
p<0.01
p<0.01
p<0.01
MLA (mm²)
25
20
15
10
5
0
3.71 (2.88-4.80)
5.52 (4.33-6.64)
12.5 (9.50-15.1)
Baseline
Stent
Post-dilation
B
p<0.01
p<0.01
p=ns
LCBI
300
200
100
0
62.5 (29.0-123)
7.5 (0.7-41.3)
4.5 (0-39.8)
Baseline
Stent
Post-dilation
C
p<0.01
p<0.01
p=ns
LCBImax
1,000
800
600
400
200
0
294 (172-435)
58.5 (2.3-227)
50.5 (0-232)
Baseline
Stent
Post-dilation
D
p<0.01
p<0.01
p=ns
LCBImla
1,000
800
600
400
200
0
142 (0-326)
0 (0-2.3)
0 (0-0)
Baseline
Stent
Post-dilation

Results

	Open cell stents	Close and hybrid cell stents	P value
Baseline LCBI	77 (25 - 176)	57 (26 - 105)	0,304
Post stent LCBI	11 (1 - 71)	7 (1 - 30)	0,258
Postdilation LCBI	9 (1 - 52)	4 (0-34)	0,170

Table 3: Lipid signal after CAS with open vs. closed or hybrid cell stents.

Effect of stenting on the near-infrared spectroscopy-derived lipid core burden index of carotid artery plaque

EuroIntervention 2019;15:e1-e8 published online jaa June 2018

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Impact on daily practice

NIRS-IVUS assessment of the carotid stenosis in patients undergoing CAS provides additional morphological and compositional information that might prove useful in tailoring the treatment strategy. The best treatment option (specifically designed stents, aggressive antithrombotic and lipid-lowering therapy or endarterectomy) for lipid-rich carotid plaques needs to be determined in future trials.

EuroIntervention IF 4,4