of the number of cigarettes or cigars smoked in a year, and even different smoking styles could affect the subject's olfactory sensitivity, representing a non-measurable factor.

Finally, the quantification of radiation exposure via the number of years of activity at Cath Lab is another limitation of the study, but it is actually the only way to perform such an analysis, considering the extremely burdensome procedure of acquiring personal dosimetry data.

However, radiation exposure seems affecting the olfactory function at both peripheral (sensitivity) and central (discrimination and identification) levels.

While further evidence is needed and limitations are present at this point, in the meantime head protection should be a mandatory good practice of safety in every Cath Lab, in order to reduce the head exposure of clinicians.

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Morphological–biohumoral correlations in acute coronary syndromes: Pathogenetic implications ☆

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Plaque rupture (PR) or plaque erosion (PE) associated with activation of inflammatory cells and with coronary thrombosis is believed to be the main cause of acute coronary syndromes (ACS) [1]. Functional alterations of large epicardial vessels and of microcirculation are other causes of coronary instability [2,3]. Yet, different markers of inflammation were found to have an independent prognostic value [4]. In the current study we have systematically assessed the morphology of the culprit stenosis, assessed by optical coherence tomography (OCT), and its correlation with markers of inflammation in the attempt to identify subsets of patients with a common mechanism of instability.

We prospectively enrolled consecutive patients admitted to our Coronary Care Unit with diagnosis of non-ST-elevation (NSTE)-ACS (n = 50), and patients with stable angina (SA) (n = 34) who underwent diagnostic coronary angiography followed by OCT of the culprit coronary stenosis between March 2010 and February 2012. A detailed description of the inclusion and exclusion criteria, as well as risk factor definition is reported in the online appendix. All patients gave their informed consent, and the study was approved by the local Ethics Committee. Frequency domain OCT images were acquired by a commercially available system (C7 System; LightLab Imaging Inc./St. Jude Medical, Westford, MA) connected to an OCT catheter (C7 Dragonfly; LightLab Imaging Inc./St. Jude Medical, Westford, MA), as previously described [5]. OCT image analysis was performed offline by 2 expert investigators (G.N., R.A.M.) who were blinded to the clinical presentation; discordance was resolved by consensus. The culprit lesion morphology was described according to previously reported criteria [6,7]. The culprit lesion was classified as PR, PE or as a stenosis without evidence of thrombus (SP). PR and PE were defined as previously described [6,7]. SP was defined as the presence of a significant stenosis (≥70% at coronary angiography and minimal lumen area ≤4 mm^2 at OCT) without superimposed thrombosis and without signs of plaque rupture. OCT images were reliable in all enrolled patients as large thrombus burden was not seen in our population. Venous blood samples were drawn from the forearm before coronary angiography at the time of hospital admission but within 12 h from chest pain onset in patients with NSTEMI. Collected samples were immediately placed on ice and stored at −80 °C.

Serum high-sensitivity CRP was measured with the use of a latex-enhanced immunonephelometric assay by BN II analyzer (Siemens Healthcare Diagnostics, Deerfield, IL, USA). Serum matrix metalloproteinase (MMP)-9 and MMP-2, MPO and Cystatin-C were measured by an enzyme-linked immunosorbent assay (Quantikine ELISA Immunoassay, R&D System, Minneapolis, MN, USA). Data distribution was assessed according to the Kolmogorov–Smirnov test. Continuous variables were compared using an unpaired Student's *t*-test or Mann–Whitney *U*-test,

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Table 1
Clinical, angiographic and OCT characteristics according to clinical presentation, and to culprit lesion morphology, as assessed by OCT.

Variables	All patients (n = 84)	ACS patients (n = 50)	SA patients (n = 34)	P	PR[a] (n = 23)	PE[a] (n = 12)	SP[a] (n = 15)	P
Clinical characteristics								
Age, mean ± SD, y	67.3 ± 9.6	67.8 ± 10.5	66.6 ± 8.1	0.6	68.6 ± 9.4	62.3 ± 8.9	70.9 ± 12.2	0.096
Male, n (%)	58 (69.0)	34 (68.0)	24 (70.6)	0.82	17 (73.9)	7 (58.3)	10 (66.7)	0.63
Risk factors, n (%)								
Smoking	35 (41.7)	20 (40.0)	15 (44.1)	0.82	7 (30.4)	9 (75.0)	4 (26.7)	0.017°
Hypertension	61 (72.6)	35 (70.0)	26 (74.5)	0.62	17 (73.9)	6 (50.0)	12 (80.0)	0.24
Hypercholesterolemia	47 (55.9)	29 (58.0)	18 (52.9)	0.66	15 (65.2)	6 (50.0)	8 (53.5)	0.62
Diabetes mellitus	20 (23.8)	14 (28.0)	6 (17.6)	0.31	7 (30.4)	2 (16.7)	5 (33.3)	0.66
Obesity (BMI > 30)	16 (19.0)	13 (26.0)	3 (8.8)	0.087	8 (34.8)	1 (8.3)	4 (26.7)	0.22
Family history of CAD	24 (28.6)	13 (26.0)	11 (32.3)	0.62	7 (30.4)	3 (25.0)	3 (20.0)	0.91
Previous history, n (%)								
Previous ACS	22 (26.2)	13 (26.0)	9 (26.5)	1.0	5 (21.7)	1 (8.3)	7 (46.7)	0.065
Previous PCI	23 (27.4)	11 (22.0)	12 (35.3)	0.22	3 (13.0)	2 (16.7)	6 (40.0)	0.17
Previous CABG	3 (3.6)	1 (2.0)	2 (5.9)	0.56	0 (0.0)	0 (0.0)	1 (6.7)	0.54
Last angina episode from sampling (h)	–	9.6 (8.2–11.5)	—	—	8.1 (6.9–9.9)	8.8 (6.5–9.6)	8.2 (6.9–10.7)	0.72
eGFR, mean ± SD, ml/min	75 ± 20	74 ± 22	77 ± 16	0.52	72 ± 18	75 ± 25	75 ± 23	0.69
Medications, n (%)								
Aspirin	58 (69.0)	31 (62.0)	27 (79.4)	0.1	14 (60.9)	8 (66.7)	9 (60.0)	1.0
Clopidogrel	14 (16.7)	8 (16.0)	6 (17.6)	1.0	2 (8.7)	2 (16.7)	4 (26.7)	0.32
Beta-blockers	56 (66.7)	31 (62.0)	25 (73.5)	0.35	13 (56.5)	7 (58.3)	11 (73.3)	0.61
ACE inhibitors	45 (53.6)	27 (54.0)	18 (52.9)	1.0	11 (47.8)	7 (58.3)	9 (60.0)	0.76
ARB	16 (19.0)	7 (14.0)	9 (26.5)	0.17	4 (17.4)	1 (8.3)	2 (13.3)	0.88
Statins	47 (55.9)	25 (50.0)	22 (64.7)	0.26	9 (39.1)	8 (66.7)	8 (53.5)	0.30
Diuretics	13 (15.5)	8 (16.0)	5 (14.7)	1.0	3 (13.0)	2 (16.7)	3 (20.0)	0.87
Oral hypoglycaemic agents	11 (13.1)	8 (16.0)	3 (8.8)	1.0	4 (17.4)	1 (8.3)	3 (20.0)	0.79
Angiographic characteristics								
Multivessel disease, n (%)	38 (45.2)	23 (46.0)	15 (44.1)	1.0	14 (60.9)	2 (16.7)	7 (46.7)	0.058
Stenosis score	2. 78 ± 1.64	2.49 ± 1.52	2.95 ± 1.76	0.07	2.57 ± 1.59	2.37 ± 1.43	2.42 ± 1.52	0.14
Extent index	0.79 ± 0.47	0.67 ± 0.37	0.88 ± 0.59	0.09	0.74 ± 0.42	0.66 ± 0.39	0.62 ± 0.34	0.12
Culprit artery, n (%)				0.73				0.91
LAD	50 (59.5)	30 (60.0)	20 (58.8)		13 (56.5)	7 (58.3)	10 (66.7)	
LCx	24 (28.6)	13 (26.0)	11 (32.4)		6 (26.1)	3 (25.0)	4 (26.7)	
RCA	10 (11.9)	7 (14.0)	3 (8.8)		4 (17.4)	2 (16.7)	1 (6.7)	
Culprit lesion analysis by OCT								
MLA, mm^2	2.47 ± 1.60	2.37 ± 1.77	2.62 ± 1.33	0.48	2.99 ± 2.24	1.89 ± 1.30	1.80 ± 0.76	0.071
Cap thickness, μm	104 ± 56	93 ± 43	121 ± 68	0.038	65 ± 30	120 ± 32	116 ± 42	<0.001*
Lipid plaque, n (%)	61 (72.6)	37 (74.0)	24 (70.6)	1.0	20 (86.9)	7 (58.3)	10 (66.7)	0.14
Fibrous plaque, n (%)	18 (21.4)	9 (18.0)	9 (26.5)	0.42	2 (8.7)	4 (33.3)	3 (20.0)	0.2
Calcified plaque, n (%)	5 (5.9)	4 (8.0)	1 (2.9)	0.64	1 (4.3)	1 (8.3)	2 (13.3)	0.8
TCFA, n (%)	24 (28.6)	14 (28.0)	10 (29.4)	1.0	11 (47.8)	1 (8.3)	2 (13.3)	0.02†
Lipid quadrants, number	2.43 ± 1.24	2.82 ± 1.10	1.85 ± 1.23	<0.001	3.13 ± 0.76	2.33 ± 1.23	2.73 ± 1.33	0.12
Microvessel presence, n (%)	25 (29.7)	17 (34.0)	8 (23.5)	0.30	8 (34.8)	3 (25.0)	6 (40.0)	0.75
Thrombus, n (%)	31 (36.9)	31 (62.0)	0 (0.0)	<0.001	19 (83.6)	12 (100.0)	0 (0.0)	<0.001‡
Red thrombus, n (%)	4 (4.7)	4 (8.0)	0 (0.0)	0.14	2 (8.7)	2 (16.7)	0 (0.0)	0.25
White thrombus, n (%)	27 (32.1)	27 (54.0)	0 (0.0)	<0.001	17 (73.9)	10 (83.3)	0 (0.0)	<0.001§

Legend: ACE: angiotensin-converting enzyme; ACS: acute coronary syndrome; ARB: angiotensin receptor blockers; BMI: body mass index; CABG: coronary artery by-pass graft; CAD: coronary artery disease; MLA: minimal lumen area; PCI: percutaneous coronary intervention; PE: plaque erosion; PR: plaque rupture; SA: stable angina; SP: severe plaque; and TCFA: thin-cap fibroatheroma.

[a] Data referred to non-ST-elevation acute coronary syndrome patients only.

° PE vs PR p = 0.03 and PE vs SP p = 0.02.

* PR vs PE p < 0.001; PR vs SP p < 0.001.

† PR vs PE p = 0.02; PR vs SP p = 0.03.

‡ PR vs PE p < 0.001; PE vs SP p < 0.001; PR vs SP p < 0.001.

§ PR vs PE p < 0.001; PE vs SP p < 0.001; PR vs SP p < 0.001.

as appropriate, and data were expressed as mean ± standard deviation or as median (range). Categorical data were evaluated using the chi^2 test. Correlation analyses were done by a Pearson test or Spearman test, as appropriate. Comparisons among more than two groups were performed by ANOVA or a Kruskall Wallis test, as appropriate, and pairwise comparisons were then carried out using Bonferroni correction. We also performed a multivariate analysis, using the logistic regression approach, having plaque morphology as dependent variable and the best cut-off value obtained by receiver operating characteristic (ROC) curve analysis for biomarker levels. Furthermore, the following variables were taken into account for adjusting for possible confounding factors: age, gender, other variables (smoking, previous ACS) showing a $p < 0.01$ at univariate analysis among risk factors and admission hs-Troponin (TnT) levels. Adjusted odds ratio with 95% confidence interval (CI) is reported in the text. All tests were two-sided, and a p-value of <0.05 represented statistically significant differences. All analyses were performed using SPSS version 19 (SPSS Inc., USA).

Baseline clinical, angiographic characteristics and OCT data are listed in Table 1. Laboratory data are shown in Table 1 online appendix. Biomarker levels according to culprit lesion morphology are shown in Fig. 1. Patients with PR had higher serum levels of CRP and MMP-9 as compared to patients with PE and patients with SP ((4.74 mg/L [0.01–31.67] vs 0.96 mg/L [0.17–4.00] vs 1.14 mg/L [0.67–9.40], respectively, p = 0.001) and (25.40 ng/mL [2.84–57.05] vs 13.25 ng/mL [6.18–29.9] vs 14.20 ng/mL [4.14–29.8], respectively, p = 0.03)) respectively, while no differences were observed between PE and SP. Patients with PE had higher plasma MPO levels as compared to patients with PR or SP (685.9 ng/mL [556.7–962.3] vs 340.0 ng/mL [108.0–604.2] vs 272.5 ng/mL [115.7–408.3], p < 0.001, respectively), while no differences were observed between PR and SP. Patients with SP had higher Cystatin-C