CHARACTERISTICS OF CULPRIT LESION MORPHOLOGY IN STEMI AND NSTEMI BY OPTICAL COHERENCE TOMOGRAPHY – A SINGLE CENTER, REAL-WORLD EXPERIENCE

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Background

- Optical coherence tomography (OCT) is an intravascular imaging modality that allows for a near microscopic level of visualization of the vessel intima (1). Detailed visualization of atheromatous plaques allows for morphological characterization and identification of different causes of acute coronary syndrome (ACS) (1,2). In the setting of a STEMI and NSTEMI, OCT evaluation pre-and post-intervention allow us to recognize the underlying cause of the event and serve as a useful tool for successful revascularization interventions.

- Our study sought to identify plaque characteristics and underlying morphology of culprit vessel lesions in ST-Segment Elevation Myocardial Infarction (STEMI) and Non-ST-Segment Elevation Myocardial Infarction (NSTEMI) patients using optical coherence tomography (OCT) imaging.

Methods and Materials

- In our retrospective, observational study we identified and studied a total population of 116 patient that underwent OCT imaging during catheterization in the University of Miami Hospital & Clinics – UHealth Tower during the period of 2011-2019.

- We selected cases that underwent cardiac catheterization in the setting of ST segment elevation myocardial infarction (STEMI) or non-ST segment elevation myocardial infarction (NSTEMI). We then analyzed and interpreted each OCT image and assessed the plaque morphology, lesion characteristics, presence of thrombus and measured each lesions detail. We used Chi-Squared test for categorical variables, and we used T-Test to compare the means.

Table 1. Baseline Demographic Table

Baseline Demographic Table	NSTEMI (N 11)	STEMI (N 12)	P Value
Age, Mean (SD)	64.4± (14.37)	60± (10.38)	0.885
Males, N (%)	6 (60)	6 (50)	1
BMI (Mean)	33.2± (11.65)	29.76± (5.48)	0.801
Hypertension, N (%)	11 (100)	12 (100)	
Hyperlipidemia, N(%)	10 (91)	11 (92)	1
Diabetes, N(%)	7 (64)	6 (50)	0.68
Smoker, N(%)	8 (73)	9 (75)	1
Family History of CAD, N(%)	11 (100)	10 (83)	0.47
Prior MI, N(%)	6 (55)	6 (50)	1
Prior PCI, N(%)	6 (55)	6 (50)	1

***Table 2.* Culprit Vessel Involved**

Culprit Vessel Involved	NSTEMI (N 11)	STEMI (N 12)	P Value
Left Anterior Descending (LAD), N (%)	5 (45.5)	7 (58.3)	0.622
Left Circumflect (LCx), N (%)	2 (18.2)	1 (8.3)	0.622
Right Coronary Artery, N (%)	3 (27.3)	4 (33.3)	0.622
OM	1 (9.1)	0 (0)	0.622

***Table 3.* Angiographic Findings**

Angiographic Findings	NSTEMI (N 1	STEMI (N 12)	P Value
50-70% Stenosis, N(%)	5 (45.4)	4 (33.3)	0.586
71-99%, N(%)	5 (45.4)	5 (41.6)	0.586
100%, N (%)	1 (9.1)	3 (25.0)	0.586

***Table 4.* Angiographic Finding <70% Stenosis**

Angiographic Finding <70%	NSTEMI (5)	STEMI (4)	Total (9)	P Value
PCI, N (%)	3 (60)	3 (75)	6 (67)	0.635
Medical Management, N (%)	2 (40)	1 (25)	3 (33)	0.635

Table 5. Optical Coherence Tomography Findings

Optical Coherence Tomography Findings	NSTEMI (N 11)	STEMI (N 11)	P Value
Plaque Morphology			
Fibrous, N (%)	5 (45.5)	5 (41.7)	0.562
Fibroatheroma (Lipid Rich), N (%)	6 (54.5)	5 (41.7)	0.562
TCFA, N (%)	0 (0)	1 (8.3)	0.562
Unstable Plaque Characteristics			
Plaque Rupture, N (%)	1 (9.1)	7 (58.3)	0.037
Plaque Erosion, N (%)	1 (9.1)	1 (8.3)	0.037
Calcified Nodule, N (%)	0 (0)	1 (8.3)	0.037
None, N (%)	9 (81.8)	3 (25.0)	0.037
Thrombus present			
Thombus, N (%)	3 (27.3)	8 (66.7)	0.059
No Thrombus, N (%)	8 (72.7)	4 (33.3)	0.059

***Table 6.* Cases of In-Stent Restenosis**

Instent Re-Stenosis (ISR)	NSTEMI (N 11)	STEMI (12)	P Value
ISR, N (%)	5 (45.5)	5 (41.7)	0.855

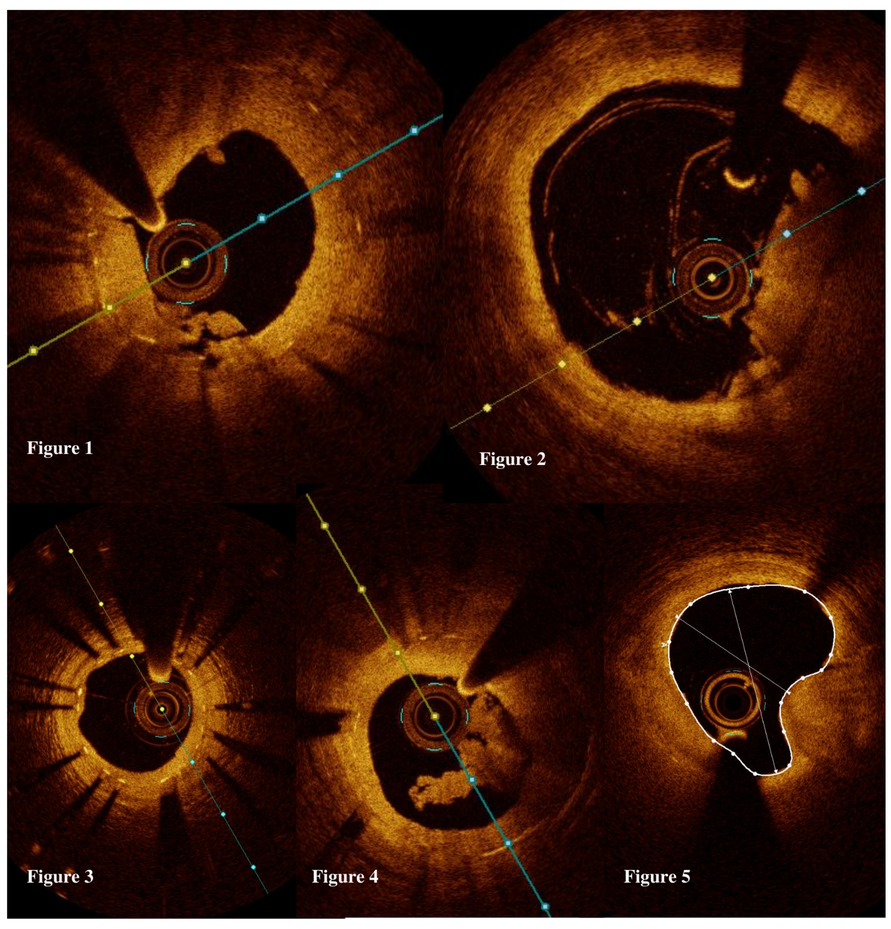

Figure 1: Optical coherence tomography (OCT) evidencing moderate in-stent restenosis (ISR) with and underlying ulcerated ruptured plaque lesion. **Figure 2:** OCT evidencing a plaque rupture with a significant thrombus. **Figure 3:** OCT image showing a significant distal edge ISR. **Figure 4:** OCT image demonstrates the presence of ISR with an in-stent thrombotic occlusion in the culprit vessel area. **Figure 5:** OCT image evidencing an eccentric plaque with evidence of inward negative remodeling consistent of plaque erosion.

Results

- Among the 116 patients who underwent OCT imaging, 12 had STEMI and 11 had NSTEMI making a total of 23 cases. Comparing STEMI versus NSTEMI, the patients with NSTEMI tended to be older (64.4 vs 57.8 years old *p:0.88*) and have a larger BMI (33 vs 30 *p:0.80*) while all other risk factors were similar. Overall, the culprit vessel for NSTEMI versus STEMI was the LAD (45% vs 58.9%) followed by the RCA (27% vs 33.3%) and LCX (18.2% vs 8.3%). Comparing OCT findings in STEMI versus NSTEMI, unstable plaque characteristics (82% vs 18% *p:0.037*) and the presence of thrombus (73% vs 27% *p:0.059*) were more frequent in the STEMI group. The most common observed unstable plaque characteristic in the STEMI group was plaque rupture (63.6%) followed by plaque erosion (9%) and calcified nodule (9%). Fibroatheromatous plaque was the most common observed morphology in NSTEMI (54.5%) and in STEMI (41.7%) cases. Among the culprit lesions that had <70% stenosis angiographically and underwent further evaluation with OCT, 67% underwent further PCI and 33% did not undergo further intervention but were treated with medical management. The observed incidence of in-stent restenosis (ISR) in the entire population studied was 43%, the most observed location for the ISR being intra-stent (50%), and the extent of disease was most frequently focal (70%).

Discussion

- Our study hints that OCT can readily identify plaque morphology and permits a better plaque assessment at the time of the intervention. A major cause of STEMI and NSTEMI is plaque rupture, but we can also observe that although plaque rupture is the most frequent inciting event for STEMI it was not observed to contribute significantly to NSTEMI in this study. Our study confirms a high incidence of visible thrombus present in the setting of STEMI. Another interesting finding of our study is the high incidence of ISR in STEMI and NSTEMI. Selection bias can explain some of the increased incidence in ISR. While the numbers remain low to make any statistically significant conclusion, the pattern of ISR suggests in NSTEMI the location of most severe disease could occur through-out the whole segment while in STEMI tend to occur exclusively within the in-stent segment.

Conclusion

- We conclude that in STEMI and NSTEMI using OCT in addition to angiographic assessment of culprit lesion may influence and optimize the treatment strategy with PCI.

Limitations

- One of the major limitations remains that this was a retrospective analysis of real-world use, and therefore a selection bias of lesions interrogated persists and complicates calculation of true incidence of overall incidence and/or prevalence of lesion characteristics.

References

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