Thrombus remains a limiting factor for achieving percutaneous coronary intervention (PCI) success during acute coronary syndrome, as it increases procedural complications (including distal embolization, no-reflow or stent malapposition) [1,2]. Thromboaspiration (TA) techniques can improve these results by reducing thrombus load within the culprit lesion, but its actual efficiency on thrombus volume remains unknown and the real benefits of the technique are debated [3]. Moreover, the angiographic assessment of residual thrombotic burden following TA is suspected to provide several inaccuracies. In this work, we assessed the feasibility of residual thrombotic burden quantification following TA by optical coherence tomography (OCT) in STEMI and its relation to angiographic parameters.

Patients with acute STEMI (symptoms onset ≤12 h) with initial TIMI 0 or 1 flow and high thrombotic burden (Thrombus TIMI grade ≥3) on culprit lesion and who benefited from successful mechanical thrombus aspiration (defined as TIMI flow ≥2 + chest pain cessation + ST elevation resolution ≥50%) with no use of balloon predilation were screened for inclusion. Our local Ethics Committee approved the study and informed consent was obtained for each patient.

All procedures were performed through radial access. Patients were treated in accordance with the European Society of Cardiology (ESC) guidelines for management of patients with STEMI [4]. PCI was performed with a 6 Fr guiding catheter in all patients. Thrombo-aspiration was performed using a manual thrombectomy device (Eliminate. TERUMO, Tokyo, Japan). The number of passes was left at the operator discretion, in order to obtain optimal flow and satisfactory angiographic result. Culprit lesion OCT analysis was performed following TA in patients with successful procedure with a commercially available system (C7 System; LightLab Imaging Inc./St Jude Medical, Westford, MA).

Two operators retrospectively reviewed coronary angiography and analyzed pre and post-thrombectomy culprit lesion characteristics, including antegrade angiographic flow, thrombus grade according to the TIMI criteria as well as the percentage of stenosis (before and after thrombectomy) by quantitative coronary angiography.

FD-OCT image analysis methods have been extensively described elsewhere [5]. Briefly, thrombi were defined as masses protruding into the vessel lumen, discontinuous from the surface of the vessel wall and characterized according to the signal characteristics. The longitudinal view was used to mark and measure the length of the atherothrombotic lesion. The outlines of lumen and thrombus were drawn for area measurements on cross-sectional images by multiple point trace function within the atherothrombotic culprit lesion in 1 mm intervals, allowing calculations of the OCT-thrombus volume, OCT-thrombus score and area stenosis. Proximal and distal reference lumen areas, as well as minimal lumen area (MLA) were measured for each lesion. References were defined as the most “normal-appearing” segments 5 mm proximal and distal to the lesion shoulders by OCT. The reference lumen area was the average of proximal and distal references lumen areas. Percent area stenosis was calculated as follows: 100 * (reference lumen area – MLA) / reference lumen area.

Data are expressed as mean and standard error to the mean (SEM). Continuous and categorical variables were compared using the Student t-test and the chi-square test or Fisher’s exact test. Univariate correlations were assessed by Pearson’s correlation or Spearman’s rho (ρ) test after log-transformation of variables.

From September 2011 to December 2012, N = 36 patients fulfilled the inclusion criteria. Three out of these subjects were excluded for inadequate image quality related to abundant red thrombus on initial analysis (inducing inability to accurately delimitate thrombus and lumen areas). Finally, n = 33 patients were included in the study. Baseline characteristics of the population are given in Table 1. Aspiration thrombotic debris was found in 91% of patients. OCT was feasible in all
cases and did not induce any complication (including embolization, artery re-occlusion or patent dissection). Residual thrombotic material was present in all cases, irrespective of the angiographic result: the residual OCT-thrombus volume and OCT-thrombus score were respectively 17.0 ± 4.0 mm³ and 23.0 ± 3.2. (See Table 2.)

OCT thrombus indices were correlated (Spearman’s \( \rho = 0.47 \), \( p = 0.02 \)) but did not correlate with any of the post-TA angiographic characteristics, including post-TA QCA (OCT thrombus volume: Spearman’s \( \rho = 0.02 \)) but did not correlate with any of the post-TA angiographic characteristics (Spearman’s \( \rho = 0.19 \), \( p = 0.3 \); OCT-thrombus score Spearman’s \( \rho = 0.22 \), \( p = 0.28 \)). However, we observed a mild correlation between degrees of stenosis estimated by angiography (QCA) and by OCT (area derived percentage) (Spearman’s \( \rho = 0.44 \), \( p = 0.02 \)).

Patients were divided into 2 groups according to the post-TA angiographic analysis: optimal (QCA \( \leq 70\% \) and sub-optimal (QCA > 70%) re-occlusion or patent dissection). Residual thrombotic material after stenting in acute myocardial infarction—The Task Force on the management of ST-segment elevation myocardial infarction of the current era (the Mayo Clinic experience), Am J Cardiol. 88 (2001) 1091–1096.

These data are in line with previous observations in non ST- and STEMI patients treated by TA and PCI, in which OCT depicted the presence of residual thrombus within stent [6,7]. Altogether, these results indicate that manual thrombectomy might have a limited role to completely remove thrombus from the culprit lesion. In this perspective, our data suggest that a 2 steps–approach (initial thrombectomy followed by deferred stenting) could be proposed in some selected STEMI patients, with the presence of abundant thrombus following initial TA [8]. An optimal medical therapy (including anticoagulation + double anti-platelet therapy) should be provided between initial and subsequent PCI, allowing adequate thrombus regression [5]. Since angiography has a limited sensitivity to detect residual thrombus, OCT might thus represent a better option to guide this specific management option.

Conflict of interest

Drs. Amabile and Caussin received consulting fees from St.Jude Medical; the other authors reported nothing to disclose in relation with the present article.

References


