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Two Different Mechanisms of Very Late Stent Thrombosis: Assessment and Guidance of Therapy with Optical Coherence Tomography

C. Roth, C. Gangl, G. Kreiner, G. Delle-Karth

Abstract: Incomplete coverage of stent struts and atherosclerosis within the neointima are the two most frequently mechanisms of very late stent thrombosis (VLST). As the determination by conventional coronary angiography is not always possible, the use of optical coherence tomography (OCT) is getting more and more important. The high resolution of OCT allows a closer look to the pathomechanisms of VLST, which helps to make the right decisions in the catheterization laboratory. These cases demonstrate the evaluation of VLST by OCT and the resulting therapeutic decisions.

Key words: very late stent thrombosis, Mechanisms of stent thrombosis, Drug eluting stents, Optical coherence tomography

Zusammenfassung: Zwei verschiedene Mechanismen der sehr späten Stentthrombose: Beurteilung und Leitfaden für die Therapie mittels optischer Kohärenztomographie. Eine unvollständige Abdeckung von Stentstruts und Arteriosklerose in der Neointima sind die beiden häufigsten Mechanismen für eine sehr späte Stentthrombose (VLST). Da die Differenzierung mittels herkömmlicher Koronarangiographie nicht immer möglich ist, spielt der

Einsatz der optischen Kohärenztomografie (OCT) eine immer wichtigere Rolle. Die hohe Auflösung des OCT erlaubt einen genaueren Einblick in die Pathomechanismen von VLST, wodurch im Herzkatheter adäquate Entscheidungen getroffen werden können. Diese Fallberichte zeigen die Evaluation von VLST mittels OCT mit den daraus abgeleiteten therapeutischen Entscheidungen. **J Kardiologie 2014; 21 (11–12): 314–7.**

Schlüsselwörter: sehr späte Stentthrombose, Mechanismus der Stentthrombose, Medikamentenbeschichtete Stents, optische Kohärenztomographie

■ Introduction

Very late stent thrombosis (VLST) is a rare but potentially catastrophic event. With an annual occurrence rate of 0.6% [1] it has emerged as an important complication of percutaneous coronary intervention (PCI) with drug eluting stents (DES) [2, 3]. Two main risk factors for VLST were identified: First, incomplete coverage of stent struts and second atherosclerosis within the neointima. Whereas delayed healing with a higher percentage of uncovered stent struts is the key factor for thrombus formation in the former [4, 5], the rupture of a vulnerable plaque within the stent and potential vessel closure form the pathological substrate for the latter. These different mechanisms of VLST are frequently difficult to assess by coronary angiography alone. Optical coherence tomography (OCT) is a valuable tool in this setting [6, 7]. We herein report on two cases with VLST after DES for which we were able to assess the underlying pathomechanism and to guide therapeutic decisions by OCT.

■ Case 1

A 65-year-old man with a medical history of hyperlipidemia and hypertension underwent PCI in May 2005 because of acute anterior myocardial infarction. A 3.0 × 28 mm sirolimus eluting stent (Cypher Select®, Cordis Corporation, Johnson & Johnson, Warren, NJ) was implanted in the proximal LAD. The patient was prescribed aspirin (100 mg/day) for long term intake and clopidogrel (75 mg/day) for 12 months as antiplatelet therapy. After 5 years and 3 months the patient was admitted to hospital for elective transurethral resection of a bladder

tumor. Aspirin had been stopped for 5 days. The patient experienced an anaphylactic reaction due to the application of hexaminolevulinate, which was injected into the bladder prior to a planned cystoscopy, with profound hypotension (RR 60/40 mmHg). Hemodynamics recovered after a volume resuscitation and the administration of antihistamines/corticosteroids but he immediately developed an acute ST-segment elevation myocardial infarction with typical chest pain and ST-elevations in chest wall leads V2–4. A bolus of 4000 units of unfractionated heparin i. v., 600 mg clopidogrel and 100 mg aspirin p. o. were given and the patient was transferred to the catheter-laboratory within 30 minutes after the onset of chest pain. The angiography revealed a very distal occlusion of the LAD and a non-significant stenosis of the sirolimus eluting stent with spotted haziness suspicious for adherent thrombi (Fig. 1). To further elucidate the pathology within the stenosis an OCT was performed (Model C7XR LightLab Imaging, Inc., Westford, MA) (Fig. 2a–d). It revealed a mildly underexpanded stent with areas of incomplete stent apposition mainly in the proximal third of the stent (Fig. 2e). Further, in 16% of all stent struts no coverage was detected. Uncovered struts were mainly observed in malapposed stent areas. White thrombi were predominantly seen in areas with uncovered struts and in areas with stent malapposition (Fig. 2a–c). Additional heparin and 250 mg aspirin i. v. were given and intravenous abciximab i. v. was started during catheterization. The patient became almost pain free during the procedure and the elevated ST-segments normalized. No PCI was performed. The peak troponin T concentration was measured on day 1 after infarction (0.43 ng/ml [normal range < 0.03]). The subsequent clinical course was uneventful and the patient left the hospital on day three after the stent thrombosis. Dual platelet inhibition therapy (DAPT) was recommended.

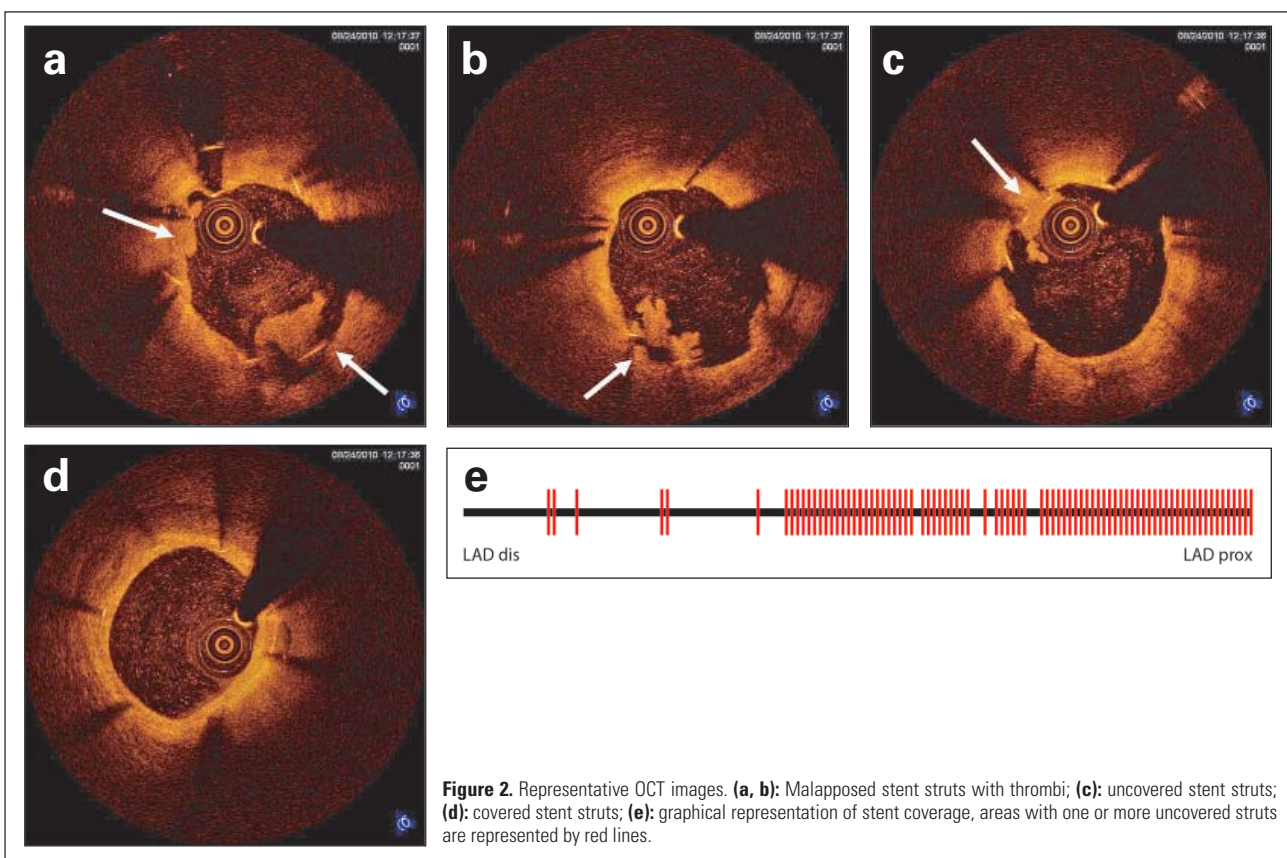
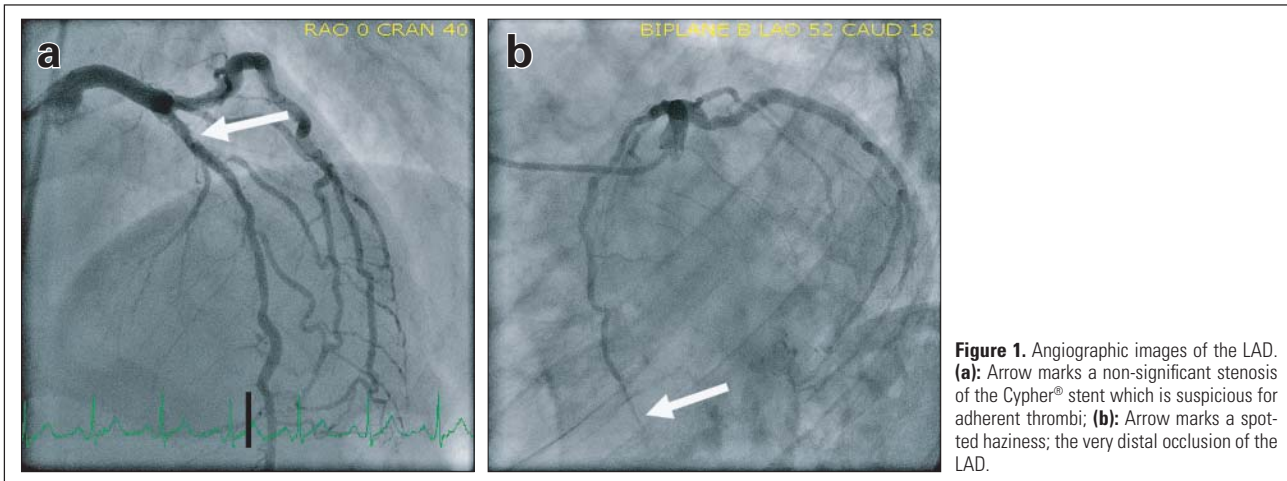
■ Case 2

A 48-year-old man underwent PCI in January 2007 with a paclitaxel eluting stent (Taxus liberté®, Boston Scientific Corpora-

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tion, Natick, MA) in the mid LAD because of a non-ST-elevation myocardial infarction. DAPT with clopidogrel for 12 months and aspirin as long-term therapy were prescribed. Because of recurrent chest pain an angiography was performed 2 years later. It revealed a significant in-stent restenosis and the patient underwent successful balloon-angioplasty. An angiographic control 12 months later showed good long-term results with no residual stenosis. Approximately 5 years after the stent implantation the patient experienced non-ST-elevation myocardial infarction and coronary angiography was performed again. It showed a significant restenosis in the distal part of the paclitaxel eluting stent (Fig. 3). OCT revealed a ruptured plaque with protruding intima-flap (Fig. 4c, d) and several, small adherent thrombi (Fig. 4a, b). Additionally a sub-occlusive dense neo-intima formation compatible with intramural

hematoma and/or a lipid rich necrotic core was detected at the site of the plaque rupture (Fig. 4c, d). The patient underwent an implantation of a new-generation everolimus eluting stent (Promus Element®, Boston Scientific Corporation, Natick, MA). Post-PCI-OCT revealed good stent expansion, adequate stent apposition with no residual stenosis or edge dissections. The patient left the hospital 3 days after PCI in good condition with a prescription for clopidogrel for 12 months and aspirin as long-term therapy.

■ Discussion

These cases represent typical examples for the two main mechanisms for VLST, in which OCT was not only helpful in establishing the diagnosis but also supported the interven-

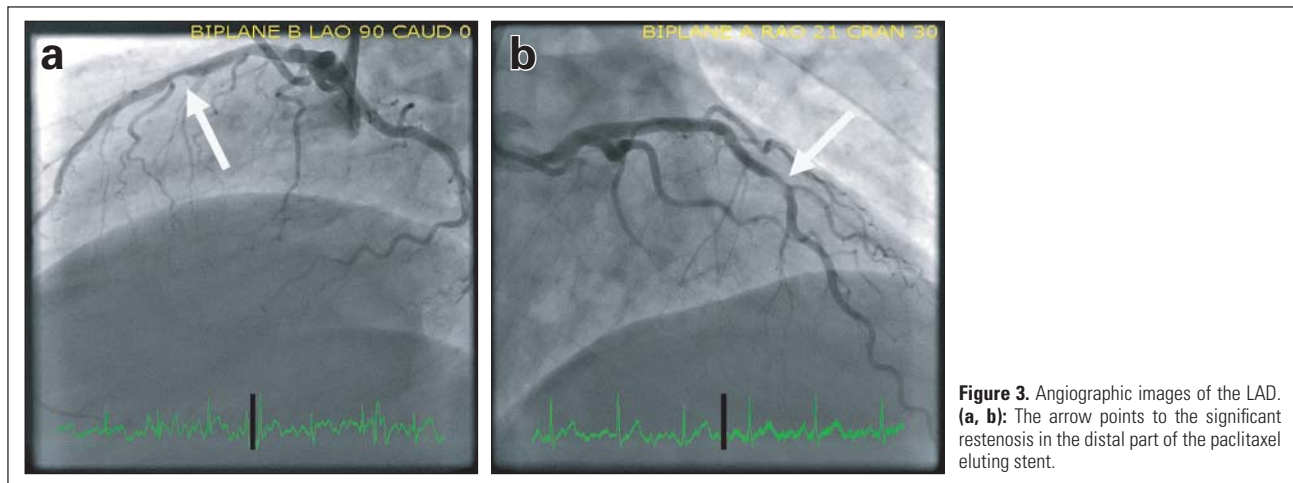


Figure 3. Angiographic images of the LAD. (a, b): The arrow points to the significant restenosis in the distal part of the paclitaxel eluting stent.

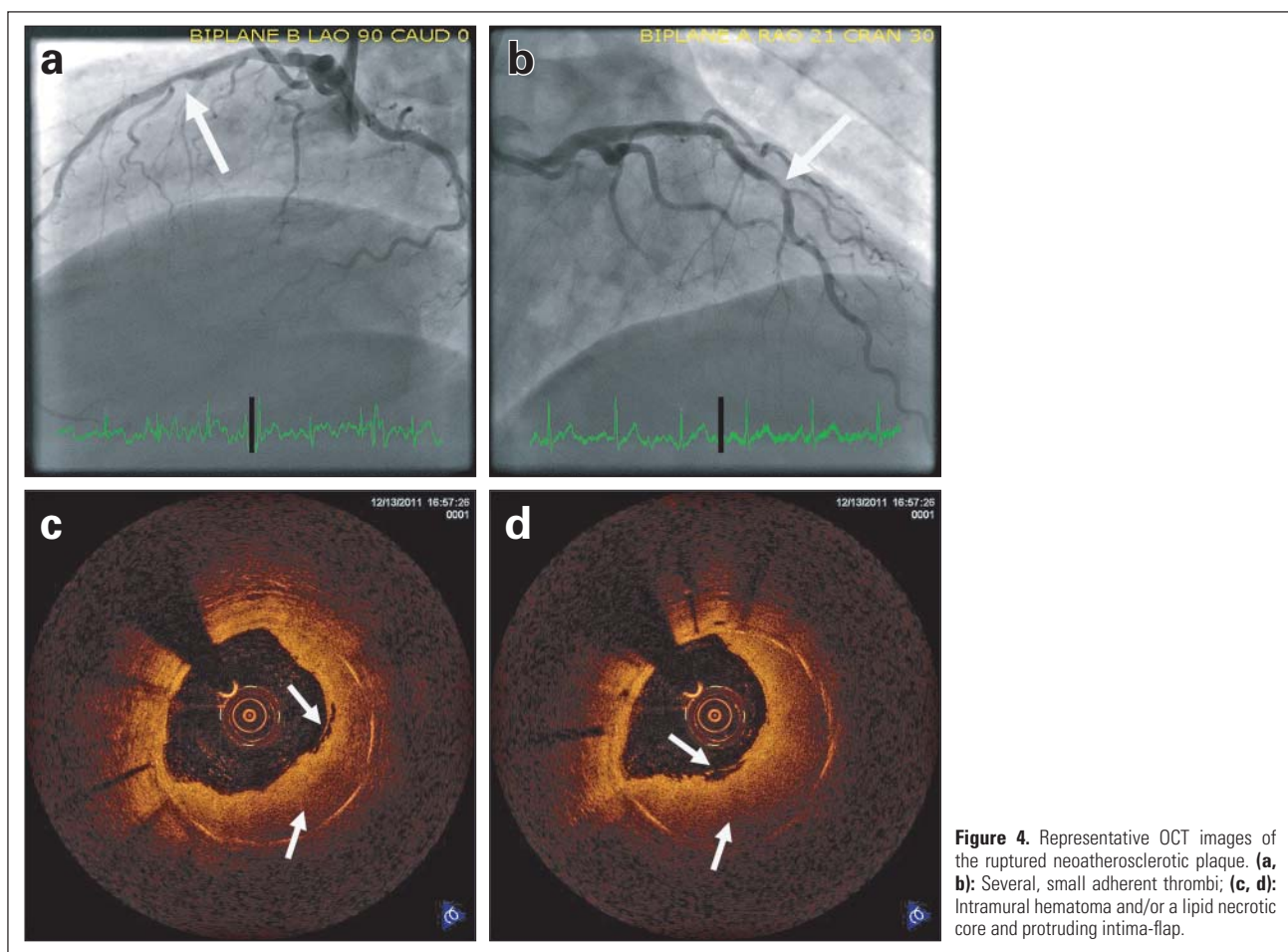


Figure 4. Representative OCT images of the ruptured neoatherosclerotic plaque. (a, b): Several, small adherent thrombi; (c, d): Intramural hematoma and/or a lipid necrotic core and protruding intima-flap.

tional and clinical decision-making. With regard to delayed stent-endothelialization as underlying mechanism for VLST recent OCT studies have underlined the importance of the percentage of uncovered stent struts and stent-vessel malapposition [8]. A significant gap between the stent and the arterial wall not only hampers adequate stent endothelialization but also promotes a prothrombotic milieu mainly because of the turbulent flow with subsequent low arterial wall shear stress [9, 10]. In our first patient 16% of all struts were uncovered even more than 5 years after the index procedure. Non-coverage was predominantly detected at the malapposed proximal third of the stent. In line with the mild underexpansion of the

stent at this site, the malapposition was probably related to the index procedure and not a result of positive remodeling. The critical question remains how to proceed with the patient during the acute PCI and in long term. With the help of the OCT findings we decided to only dissolve the thrombi and to place the patient on DAPT with aspirin and clopidogrel again. Alternative solutions would have been to perform high-pressure balloon angioplasty with a non-compliant balloon at the site of the malapposition. Nevertheless one must be aware that due to closed cell design of the Cypher® Stent a balloon-angioplasty might not be as effective as with newer generation DES and that a new vessel trauma because of balloon angioplasty could

potentially trigger further clinical events. Since healing of the stent struts cannot be expected in the future, any complete interruption of DAPT again puts the patient at an increased risk of stent thrombosis and whenever possible surgical interventions should at least be performed under the condition of continuous aspirin administration. If the surgical bleeding risk is estimated too high an alternative approach could be to stop the oral antiplatelet therapy but to install an infusion with a short acting GPIIb/IIIa inhibitor prior to surgery instead and to restart it in the postoperative phase.

In contrast to VLST caused by incomplete stent healing, in-stent neoatherosclerosis seen in DES [11, 12] is characterized by excessive neointima formation and accelerated atherosclerosis. These dynamic changes are probably induced by pro-inflammatory and/or hypersensitivity responses after the DES implantation. The OCT findings of our second patient showed important elements of unstable atherosclerotic plaque: a thin and ruptured fibrous cap, adherent thrombi and a dense intramural formation compatible with intramural hematoma and/or necrotic lipid rich core. In accordance with these OCT findings we decided to place a newer generation stent at the site of the plaque rupture.

■ Conclusion

Our cases demonstrate that with the help of high resolution OCT the differentiation of the two main mechanisms for VLST can be performed with high accuracy. This differentia-

tion and detailed insights in the underlying pathomechanism may have an important impact on interventional and clinical decision-making.

■ Conflict of Interest

The authors declare that they have no conflict of interest.

References:

1. Daemen J, Wenaweser P, et al. Early and late coronary stent thrombosis of sirolimus-eluting and paclitaxel-eluting stents in routine clinical practice: data from a large two-institutional cohort study. *Lancet* 2007; 369: 667–78.
2. Morice MC, Serruys PW, Sousa JE, Fajadet J, Ban Hayashi E, et al. A randomized comparison of a sirolimus-eluting stent with a standard stent for coronary revascularization. *N Engl J Med* 2002; 346: 1773–80.
3. Jensen LO, Maeng M, Kalltoft A, Thaysen P, Hansen HH, et al. Stent thrombosis, myocardial infarction, and death after drug-eluting and bare-metal stent coronary interventions. *J Am Coll Cardiol* 2007; 50: 463–70.
4. Finn AV, Joner M, Nakazawa G, Kolodgie F, Newell J, et al. Pathological correlates of late drug-eluting stent thrombosis: strut coverage as a marker of endothelialization. *Circulation* 2007; 115: 2435–41.
5. Honda Y. Drug-eluting stents: Insights from invasive imaging technologies. *Circ J* 2009; 73: 1371–80.
6. Namas W, Ligthart JM, et al. Optical coherence tomography for evaluation of coronary stents in vivo. *Expert Rev Cardiovasc Ther* 2013; 11: 577–88.
7. Kubo T, Tanaka A, et al. Application of optical coherence tomography in percutaneous coronary intervention. *Circ J* 2012; 76: 2076–83.
8. Guagliumi G, Sirbu V, et al. Examination of the in vivo mechanisms of late drug-eluting stent thrombosis: findings from optical coherence tomography and intravascular ultrasound imaging. *JACC Cardiovasc Interv* 2012; 5: 12–20.
9. Hou JB, Meng LB, et al. Combined use of optical coherence tomography and intravascular ultrasound during percutaneous coronary intervention in patients with coronary artery disease. *Zhonghua Xin Xue Guan Bing Za Zhi* 2008; 36: 980–4.
10. De Santis G, Conti M, et al. Haemodynamic impact of stent-vessel (mal)apposition following carotid artery stenting: mind the gaps! *Comput Methods Biomech Biomed Engin* 2013; 16: 648–59.
11. Nakazawa G, Otsuka F, et al. The pathology of neoatherosclerosis in human coronary implants bare-metal and drug-eluting stents. *J Am Coll Cardiol* 2011; 57: 1314–22.
12. Otsuka F, Nakano M, et al. Pathologic etiologies of late and very late stent thrombosis following first-generation drug-eluting stent placement. *Thrombosis* 2012; 2012: 608593.

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