Original article

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CLINICAL AND ANGIOGRAPHIC CHARACTERISTICS OF PATIENTS WITH STENT THROMBOSIS

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Stent thrombosis (TS) after percutaneous coronary intervention (PCI) is a rare but potentially fatal complication with an incidence of 1% to over 5%. Risk factors for TS can be divided into factors related to the patient, procedure, stent type and characteristics of the lesion.

One thousand fifty-five patients who underwent PCI during 2009 and 2010 were included into the study and followed during the next year. Patients with and without definite TS formed the study (TS+) and control group (TS+), respectively.

Twenty-three patients had TS (2,2%). Early, late and very late TS were noted in 69,5%, 13,1% and 17,4% of patients, respectively. Acute myocardial infarction with ST-segment elevation was the most frequent clinical presentation (56,6%). Discontinuation of aspirin and/or clopidogrel (34.8%) and resistance to these drugs (34.7%) were the main patient-related factors for TS. A higher percentage of stenosis of lesions (92 ± 12 vs 86 ± 14), greater average stent length (19.69 vs 17.01 mm), lower pressure stent insufflation (14.84 vs. 16.02 atm) and coronary artery dissection (26.1%) were significant reasons for the occurrence of TS. Similar stent type - BMS („bare metal stents) and DES („drug eluting stents") were applied in both of patient groups.

STEMI patients and those with impaired systolic left ventricular function are at highest risk of TS, which is reported in more than two thirds of them in the first 30 days after PCI. Discontinuation of aspirin and/or clopidogral or resistance to these drugs led to TS. Greater stent length, small diameter of the stent ("underestimated lesion"), lower pressure insufflation and dissection of the coronary artery are the most common procedural reasons for the occurrence of TS. Type of stent (BMS and DES) had no significant effect on the occurrence of TS. *Acta Medica Medianae 2013;52(4):5-11.*

Key words: *percutaneous coronary intervention, stent thrombosis*

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Introduction

Stent thrombosis (TS) after percutaneous coronary intervention (PCI) is a rare but potentially fatal complication. The rate of TS in the literature varies from one study to another, ranging from 1% to over 5% (1-4). This variation in the incidence of TS is caused due to several reasons including the definition of TS, stent type, time when the study was conducted, type and duration of application of antiplatelet therapy, relationship between patients with stable angina pectoris (SAP) and patients with acute coronary syndrome (ACS) etc. Risk factors for TS can be divided into factors related to the patient, procedure, stent type and characteristics of the lesion. The patient-related factors are: interruption of antiplatelet therapy, resistance to antiplatelet therapy, diabetes mellitus, renal failure and ACS. The procedure-related factors are: procedural complications (eg., coronary artery dissection), inadequate size of the stent or inadequate stent implantation. The type of stent is the most important stent-related factor: BMS (bare metal stents) or drug-coated stents - DES (drug-eluting stets).

Aims

The aim of this paper is to present the incidence, clinical, angiographic, and procedural characteristics of patients with TS in the real, everyday practice.

Methods

The study included 1.055 consecutive patients who underwent PCI from July 2009 to June 2010 who were followed for the next two years, until the end of June 2012. PCI was performed for

patients with SAP (elective PCI), unstable angina pectoris (UAP) and non-Q myocardial infarction (NSTE-ACS), and patients with acute myocardial infarction with ST-segment elevation (STEMI). Twenty three patients with definite TS and 70 patients without TS formed the study group (TS +) and control group (TS-), respectively, but the latter was chosen randomly. Definite TS was defined by the criteria of the ARC (Academic Research Consortium). Namely, TS must be confirmed by angiography in the form of partial or complete occlusion within a previously implanted stent or in the segment 5mm proximal or distal to the stent and the presence of at least one of the following criteria: a new beginning acute ischemic symptoms at rest, new ECG changes indicating acute ischemia, or typical rise and fall of cardiac biomarkers. Stent thrombosis occurring 0 to 24 hours, >24 hours to 30 days, >30 days to 1 year and >1 year after stent implantation was defined as acute, subacute, late and very late, respectively (5).

Three hundred and twenty-four patients, of the total number of patients with PCI, had STEMI. Patients with SAP and NAPs had already been on dual antiplatelet therapy (DAPT) (aspirin 100mg and clopidogrel 75mg daily), and if not, as well as patients with STEMI, at admission were prescribed aspirin 300mg and 600mg clopidogrel with standard heparin or enoxaparin, statin and the other therapy according to the guidelines for the treatment of NSTE-ACS and STEMI and revascularization (6). DAPT is recommended for one year to all patients with ACS and performed PCI.

All patients had the basic laboratory tests performed (elective patients prior to admission), patients with ACS cardiospecific enzyms and troponin I too, ECG on admission and ECG series after that. Test of platelet aggregation (Multiplate analyzer, Dynabyte, Munich, Germany) was performed in all patients with TS, but not other patients with routine PCI, which showed resistance to aspirin and/or clopidogrel.

Transthoracic echocardiography was done to ambulatory patients with SAP before PCI, and to patients with ACS on the device ALOKA Pro Sound 4000 before entering the cath lab.

Diameter of stenosis was assessed visually on coronary angiography. Angiographic thrombus was defined as a filling defect seen in two or more projections surrounded by contrast. It is thought that the small diameter of the stent was deployed if at least one of the following criteria was met: the stent to the reference segment coronary artery diameter ratio was <1, discrepancy between the stent and the line of the wall of coronary artery and mismatch of the stent size and proximal and distal segment artery in which PCI was performed (3).

Table 1. Clinical characteristics of examined patients

Variables	TS + (n=23)	TS – (n=70)	p
Age (years)	55,9 ± 10,7	57,8 ± 9,5	NS
Male, n (%)	16 (69,6)	50 (71,4)	NS
Presentation, n (%)			< 0,005
SAP	9 (39,1)	46 (65,7)	
NSTE-ACS	1 (4,3)	10 (14,3)	
STEMI	13 (56,6)	14 (20)	
Risk factors for CAD, n (%)			
Smoking (current)	14 (60,9)	15 (21,4)	< 0,02
Hypertension	15 (65,2)	50 (71,4)	NS
Family history of CAD	11 (47,8)	33 (47,1)	NS
Dyslipidemia	13 (56,5)	33 (47,1)	NS
Diabetes mellitus	4 (17,4)	17 (24,3)	NS
BMI (kg/m2)	27 ± 2,7	27,1 ± 3	NS
CKD (eGRF<60ml/min./1,73m^2), n (%)	2 (8,7)	2 (2,9)	NS
Prior MI, n (%)	10 (43,5)	30 (42,9)	NS
NYHA ≥ 2, n (%)	9 (39,1)	12 (17,1)	< 0,02
EF LV (%)	42,3 ± 8,1	49,8 ± 9,7	< 0,001
Discontinuation of DAPT, n (%)			
Aspirin	1 (4,3)	-	NS
Clopidogrel	6 (26,1)	-	< 0,001
Aspirin + Clopidogrel	1 (4,3)	-	NS
Resistance to DAPT, n (%)			
Aspirin	1 (4,3)	-	NS
Clopidogrel	7 (30,4)	-	< 0,001

SAP=stable angina pectoris, NSTE-ACS=acute coronary syndrome without ST-segemt nelevation, STEMI=acute myocardial infarction with ST-segment elevation, CAD=coronary artery disease, BMI=body mass index, CKD=chronic kidney disease, eGFR=estimated glomerular filtration rate, MI=myocardial infarction, NYHA=New York Heart Association class, EF=ejection fraction, LV=left ventricle, DAPT=dual antiplatelet therapy

Statistical analysis

Data are presented as mean ± SD or as percentages (proportions). Statistical analysis was performed using Student's t-test for continuous variables. The Chi-square test and Fischer's exact probability test were used to analyze the differences in categorical variables. Values of p <0.05 were considered statistically significant. All statistical analyses were performed using SPSS version 16.0 (IBM, Armonk, NY, USA).

Results

1. Clinical characteristics : During the study period 1.055 patients underwent PCI with stent implantation. Similar demographic characteristics and percentages of risk factors for coronary heart disease were noted in both groups, except for smoking, which was more frequently recorded in patients with TS+ (60.9 vs. 21.4%, p<0,02). STEMI was an indication for PCI more often in patients with TS+ (56.6% vs 20%, p<0.005) (Table 1). NYHA class≥ 2 (39.1% vs. 17.1%, p <0.02) and a lower left ventricular ejection fraction (EF) (42.3±8.1 vs 49.8±9.7, p<0.001) were noted more often in patients with TS+. Discontinuation of aspirin (4.3%) or clopidogrel (26.1%, p <0.001) or both of them (4.3%), as resistance to aspirin (4.3%) or clopidogrel (30,4%, p<0.001) were the main reasons for TS+ in more than 1/3 patients with TS+.

Table 2. Angiographic characteristics of examined patients

Variables	TS + (n=23)	TS – (n=70)	p
Coronary angiogram			NS
Multivessel disease, n (%)	10 (43,5)	37 (52,9)	
LAD, n (%)	13 (56,5)	38 (54,3)	
LCx, n (%)	4 (17,4)	11 (15,7)	
RCA, n (%)	6 (26,1)	21 (30)	
No. of vessels with > 50% stenosis	1,5 ± 0,8	1,6 ± 0,8	
Left main disease, n (%)	1 (4,3)	6 (8,6)	
Lesion characteristics, n (%)			
A	1 (4,3)	4 (5,7)	NS
B1	3 (13)	19 (27,1)	NS
B2	14 (60,9)	31 (44,3)	NS
C	5 (21,7)	16 (22,9)	NS
Ostial segment	2 (8,7)	3 (4,3)	NS
Proximal segment	15 (65,2)	25 (35,7)	< 0,05
Medial segment	4 (17,4)	40 (57,1)	< 0,001
Distal segment	2 (8,7)	2 (2,9)	NS
TIMI flow before PCI			< 0,001
TIMI 0	14 (60,9)	15 (21,4)	
TIMI 1	-	5 (7,1)	
TIMI 2	8 (34,8)	11 (15,7)	
TIMI 3	1 (4,3)	39 (55,8)	
Procedural characteristics			
Anticoagulation at PCI, n (%)			NS
Heparin	17 (73,9)	64 (91,4)	
Enoxaparin	6 (26,1)	6 (8,6)	
No. of stented lesions, n (%)	1,09 ± 0,29	1,17 ± 0,42	NS
% stenosis of stented lesions	92 ±12	86 ± 14	< 0,05
No. of stents, n (%)	1,43 ± 0,79	1,41 ± 0,67	NS
Stent length (mm)	19,69 ± 5,07	17,01 ± 5,85	< 0,05
Stent diameter (mm)	2,87 ± 0,35	3 ± 0,42	NS
Undersizing of the stent ("underestimated lesion"), n (%)	5 (21,7)	3 (4,3)	< 0,01
Stent insufflation pressure (atm)	14,84 ± 2,68	16,02 ± 2,5	< 0,05
Coronary artery dissection, n (%)	6 (26,1)	6 (8,6%)	< 0,005
TIMI flow after PCI, n (%)			< 0,025
TIMI 2	7 (30,4)	7 (10)	
TIMI 3	16 (69,6)	63 (90)	
Stent type, n (%)			NS
BMS	16 (69,6)	51 (72,9)	
DES	7 (30,4)	19 (27,1)	
Type of intervention in TS+, n (%)			
PCI with stent deployment	11 (47,8)	-	
POBA	11 (47,8)	-	
Thrombus aspiration	1 (4,4)		
TS outcome, n (%)			
STEMI	22 (95,7)	-	
Death	1 (4,3)	-	

LAD=left anterior descending artery, LCx=left circumflex artery, RCA=right coronary artery, TIMI=Thrombolysis In Myocardial Infarction, POBA=Plain Old Balloon Angioplasty

Table 3. The incidence of TS according to ARC and type of the stent

Type of TS, n (%)	BMS n (%)	DES n (%)	Totally
Early (0-30 days)*			
Acute (≤24h)	8 (34,8)	-	8 (34,8)
Subacute (>24h)	4 (17,4)	5 (21,7)	9 (39,1)
Late (31-365 days)*,†	-	2 (8,7)	2 (8,7)
Very late (>365 days)*,†	4 (17,4)	-	4 (17,4)
Totally	16 (69,6)	7 (30,4)	23 (100,0)

BMS vs DES/BMS+DES: *NS early vs late, late vs very late, early vs very late;†p<0,05 late vs very late
ARC= Academic Research Consortium

2. Angiographic characteristics: Definite TS+ was registered in 23 patients (2.2%). A total of 33 and 99 stents were applied in TS+ and TS- groups, respectively. Left main disease, multi-vessel disease, the number of vessels with stenosis larger than 50%, the stented vessel, and the type of lesions did not differ significantly between the groups (Table 2).

TS+ patients had more often TIMI 0 flow (60.9% vs 21.4%, p<0.001). The average number of stented lesions did not differ between the groups, but the percent of stenosis of treated lesions (92±12% vs 86±14%, p<0.05) and the average length of stent (19.69±5.07 vs. 17.01± 5.85mm, p<0.05) were significantly larger in TS+ group. The average number of implanted stents did not differ among the groups, but stent diameter was smaller in TS+ group while smaller stents than optimal ("underestimated lesion") were more often delivered in TS+ group (21.7% vs 4.3%, p<0.01). The insufflation pressure (14.84±2.68 vs. 16.02±2.5atm, p<0.05) was lower in the TS+ group and coronary artery dissection was more often in TS+ group (26.1% vs. 8.6%, p<0.005). Similar type of stent (DES vs BMS) was deployed in both of groups. Chest pain and ST segment elevation (STEMI) appeared in the majority of TS+ patients and one death was reported (4.3%) 13 days after stent implantation.

BMS were the most common in TS+ group (69.6%) and by far the largest number of TS occurred within 30 days after PCI ("early TS") (17 patients or 73.9%). DES were applied in 2 patients with late TS+, but BMS were implanted in all of 4 patients with very late TS+ (17.4%) (Table 3).

Discussion

Incidence of definite TS+ was 2.2% in our sample. These figures are similar to the results of the other authors (7), since its incidence varies from 1% to over 5%, depending on inclusion criteria and definition of TS+. Thus, Iqbal et al. found TS+ in 1.9% of patients (8), and van Werkum in 2.1% of patients, with a similar incidence of acute TS (32%), subacute (41,2%) and very late TS (13.5%) as in our study, while a late TS was observed more frequently (13,3%) (3). Cumulative incidence of TS+ in studies with DES was even higher, particularly with earlier generations of DES (with paclitaxel and sirolimus), while new DES generations (with everolimus) caused lower incidence of TS+ (9). Fortunately, the incidence of TS+ has been lower in the recent years because of improved stent design, use of higher rate of pressures and powerful DAPT during stent implantation (10).

There are no significant differences in demographic characteristics and some risk factors between TS+ and TS-groups, as in the study by van Werkum et al. (11). However, smoking was significantly more present in our patients (60.9% vs. 21.4%, p<0.02). Also, STEMI was the most common presentation preceding TS+, which is in keeping with the results of other authors. It has been already shown that there is a difficult choice of optimal stent size because of large thrombotic burden and consequent vasoconstriction in STEMI in addition to hypercoagulable state. Our results confirmed that patients with PCI for ACS, especially STEMI, were under much greater risk for TS+, which is in accordance with literature data showing that ACS is one of the main predictors of TS+. Also, higher NYHA class and low left ventricular EF were registered signifi-cantly more often in TS+ patients compared to TS- patients, as shown by other authors. Thus, these authors found reduced left ventricular function (EF <30%) twice as many in patients with TS+ compared to TS- patients (16.4% vs. 8.2%).

Procedural complications as coronary artery dissection (26.1%) or greater average stent length (19.69 vs. 17.01mm, p<0.05), smaller stent diameter (2.87 vs 3.0 mm), lower pressure stent insufflation (14.84 vs 16.02 atm, p<0.05), the "underestimated lesions" and the use of smaller diameter stent than optimal (21.7% vs 4.3%, p<0.01) were the main reasons for the appearance of TS+ in our study. The incidence of inadequate stent implantation or use of smaller stent than necessary was 20-30%, as shown by previous studies. Therefore, this percentage was even higher when it was assessed by intravascular ultrasound (IVUS). Severe calcification or large thrombotic burden with consequent vasoconstriction are the most common reasons for deployment of a stent smaller than necessary, but in some cases by incorrect assessment of the true size of the coronary arteries by the operator probably (3).

The percentage of patients with deployed smaller stent would probably be higher in our study and similar to data from literature if IVUS was used in postprocedural analysis. Coronary artery dissection is the most common reason for TS+ revealed by IVUS, but this device was helpful in finding the cause of TS+ in even 22% of the patients (12).

Discontinuation of DAPT or resistance to it caused TS in more than two thirds of cases similarly to the results of other authors (3,13). Pfisterer et al. analyzed more than 700 patients with implanted DES and BMS in the ratio 2:1. The rate of adverse events (death or myocardial infarction - IM) did not differ between the two groups of patients after 18 months of follow-up, until some patients stopped taking clopidogrel. The rate of adverse events was significantly higher in the DES group (4.9% vs 1.3%) at that moment (14). The cumulative incidence of TS+ after 3 years of follow-up was 2% in one large study with 23. Five hundred patients with placed DES, with no difference in relation to the type of DES (with sirolimus vs paclitaxel). Nearly one third of patients (31.6%) stopped taking DAPT because of low compliance in 70% of these patients. The rest of these patients did it because of bleeding, surgery or allergic reaction to DAPT (15). A similar proportion of patients stopped taking aspirin and/or clopidogrela in our study (34.7%). Inadequate comprehension of the importance of regular use of DAPT seemed to be the main reason for cessation of taking DAPT, but regular use or availability of certain drugs particularly clopidgrel were affected by economics in some patients.

A resistance to DAPT was the cause of TS in more than one third of patients with TS+, besides their poor compliance and/or financial resources. The first study which assessed the clinical significance of poor response to clopidogrel ("non-responders") was on 105 patients with stable coronary artery disease. The authors found that up to 11% of patients did not respond to clopidogrel, and up to 26% had a partial response to the drug ("semi-responders"). A subacute TS occurred 6 days after PCI in 2 out of 5 "non-responders" (16). Lev et al. found non-responsiveness to aspirin, clopidogrel and dual nonresponsiveness in 12.7%, 24% and 47.4% of patients, respectively. Women with higher BMI (33.8kg/m2) represented the majority of patients with dual nonresponsiveness (to aspirin and clopidogrel) (17). Other authors find, however, resistance to aspirin, clopidogrel and dual resistance in 11.5%, 6% and 6% of patients, respectively, in more than 800 patients with implanted DES and definite TS in 4.4% of dual-resistant patients (18).

TS+ group of patients underwent PCI with implantation of a new stent in less than one half of cases (47.8%), and the others underwent balloon dilatation (POBA, in 47.8% of patients) and thrombus aspiration (in 4.4%), which results are similar to findings of other authors (11). Unfortunately, the GP IIb / IIIa inhibitors were often unavailable during the study period.

There is a higher prevalence of BMS compared to DES in early vs very late TS, DES getting a greater role with elapse of time in the occurrence of TS.

Spaulding et al. did not find a significant difference in the survival rate and cumulative incidence of TS after one year and after four years of follow-up between patients who received BMS (4%) and DES with sirolimus (3.6%), though DES dominate in the group with a very late TS (19-21). A share of BMS increased progressively in the occurrence of very late TS, and was even higher, when authors considered the probable and possible TS besides definite TS (2). A greater availability and better choice of BES may be the reasons for more deployed BMS compared to DES in patients with very late TS in our study.

Kastrati et al. analyzed 14 studies with nearly 5.000 patients comparing BMS and DES (with sirolimus) and showed that the incidence of fatal outcome and IM, as well as the overall risk of TS, did not differ significantly between patients with BMS and DES, but after the first year of follow up TS significantly more frequently presented in the BMS group. It is difficult to explain why the rate of TS is similar between BMS and DES after one year of follow-up if postponed endothelialization is the main mechanism of delayed TS, despite the fact that BMS lead to faster healing of the artery wall. However, there was a slight increase of risk of TS in DES patients in a further four-year follow-up, but there was no statistically significant difference between BMS and DES group (22,23).

Mauri et al. found no significant difference in the incidence of TS between BMS and DES group (sirolimus and paclitaxel) after 4 years of follow up of more than 2.200 patients in each group, which is similar to our results, although non-availability of DES or all dimensions of DES contributed to it in our study, and the use of BMS was sometimes forced.

The mechanism of early thrombosis after the use of BMS is the result of platelet activation and inflammatory changes that occur after stent deployment and the ability of stented area for reendothelialization after PCI. The endothelialization process is thought to be complete after 1–4 months of BMS use. Several mechanisms have been proposed to explain very late TS as it occurs long after completing the endothelialization process, such as delayed endothelialization, diffuse in-stent restenosis, plaque disruption near the stented area and stenting of necrotic or ulcerated plaques. Very late TS may occur more than 10 years after BMS deployment, although very late TS is much commonly described after the use of DES. Performing the best possible PCI is the best way to avoid this often fatal complication. However, a better definition of optimal duration of DAPT in patients

with stents remains to be further developed and a long-term follow-up is of utmost importance (25).

Conclusions

The risk of TS is increased in patients with STEMI and impaired systolic function of the left ventricle. Discontinuation of DAPT and resistance to it are common reasons related to patient characteristics. The higher percent of stenosis of stented lesions, greater stent length, small stent diameter („underestimated lesion"), lower insufflation pressure and coronary artery dissection are procedure-related factors causing TS. TS occurs most usually in almost three-quarters of cases during the first 30 days after PCI, more often after BMS deployment.

References

1. Thayssen P, Jensen LO, Lassen JF, Tilsted HH, Kaltoft A, Christiansen EH, et al. The risk and prognostic impact of definite stent thrombosis or in-stent restenosis after coronary stent implantation. EuroIntervention 2012; 8: 591-8. [CrossRef] [PubMed]
2. Spaulding C, Teiger E, Commeau P, Varenne O, Bramucci E, Slama M, et al. Four year follow-up of TYPHOON (Trial toAssess the Use of the CYPHer Sirolimus-Eluting Coronary Stent in Acute Myocardial Infarction Treated With BallOON Angioplasty). J Am Coll Cardiol Intv 2011;4: 14–23. [CrossRef] [PubMed]
3. van Werkum JW, Heestermans AA, Zomer AC, Kelder JC, Suttorp MJ, Rensing BJ, et al. Predictors of coronary stent thrombosis. The Dutch Stent Thrombosis Registry. J Am Coll Cardiol 2009; 53(16): 1399–409. [CrossRef] [PubMed]
4. Heestermans AACM, Van Wekum JW, Zwart B, Van der Heyden JA, Kelder JC, Breet NJ, et al. Acute and subacute stent thrombosis after primary percutaneous coronary intervention for ST-segment elevation myocardial infarction: incidence, predictors and clinical outcome. J Thromb Haemost 2010; 8: 2385–93. [CrossRef] [PubMed]
5. Cutlip DE, Windecker S, Mehran R, Boam A, Cohen DJ, van Es GA, et al. Clinical end points in coronary stent trials : a case for standardized definitions. Circulation 2007; 115: 2344-51. [CrossRef] [PubMed]
6. Wijns W, Kolh P, Danchin N, Di Mario C, Falk V, Folliguet T, et al. Guidelines on myocardial revascu larization. The Task Force on Myocardial Revascu larization of the European Society of Cardiology (ESC) and the European Association for Cardio-Thoracic Surgery (EACTS). European Heart Journal 2010;31:2501–55. [CrossRef] [PubMed]
7. D'Ascenzo F, Bollati M, Clementi F, Castagno D, Lagerqvist B, de la Torre Hernandez JM. Incidence and predictors of coronary stent thrombosis: Evidence from an international collaborative meta-analysis including 30 studies, 221,066 patients, and 4276 thromboses. Int J Cardiol 2013 Jul 31;167(2): 575-84. [CrossRef] [PubMed]
8. Iqbal J, Sumaya W, Tatman V, Parviz Y, Morton AC, Grech ED, et al. Incidence and predictors of stent thrombosis: a single-centre study of 5,833 conse cutive patients undergoing coronary artery stenting. EuroIntervention 2013; 9: 62-9. [CrossRef] [PubMed]
9. Raber L, Magro M, Stefanini GG, Kalesan B, van Domburg RT, Onuma Y, et al Very late coronary stent thrombosis of a newer-generation everolimus-eluting stent compared with early-generation drug-eluting stents. A prospective cohort study. Circulation 2012; 125:1110-21. [CrossRef] [PubMed]
10. Uren NG, Schwarzacher SP, Metz JA, Lee DP, Honda Y, Yeung AC, et al. Predictors and outcomes of stent thrombosis. An intravascular ultrasound registry. Eur Heart J 2002; 23: 124–32. [CrossRef] [PubMed]
11. van Werkum JW, Heestermans AACM, de Korte FI, Kelder JC, Suttorp MJ, Rensing BJWM, et al. Long-term clinical outcome after a first angiographically confirmed coronary stent thrombosis: An analysis of 431 cases. Circulation 2009; 119: 828-34. [CrossRef] [PubMed]
12. Cheneau E, Leborgne L, Mintz GS, Kotani J, Pichard AD, Satler LF, et al. Predictors of subacute stent thrombosis : Results of a systematic intravascular ultrasound study. Circulation 2003;108: 43-47. [CrossRef] [PubMed]
13. Orford JL, Lennon R, Melby S, Fasseas P, Bell MR, Rihal CS, et al. Frequency and correlates of coronary stent thrombosis in the modern era. J Am Coll Cardiol 2002; 40:1567–72. [CrossRef]
14. Pfisterer M, Brunner-La Rocca HP, Buser PT, Rickenbacher P, Hunziker P, Muelleret C al. Late clinical events after clopidogrel discontinuation may limit the benefit of drug-eluting stents. An observational study of drug-eluting versus bare-metal stents. J Am Coll Cardiol 2006;48: 2584–91. [CrossRef] [PubMed]
15. de la Torre-Hernandez JM, Fernando Alfonso F, Hernandez F, Elizaga J, Sanmartin M, Pinar E, M, et al. Drug-eluting stent thrombosis. Results from the multicenter Spanish registry ESTROFA. J Am Coll Cardiol 2008;51:986–90. [CrossRef] [PubMed]
16. Muller I, Besta F, Schulz C, Massberg S, Schonig A, Gawaz M. Prevalence of clopidogrel non-responders among patients with stable angina pectoris scheduled for electice coronary stent placement. Throm Haemost 2003; 89: 783-7. [PubMed]
17. Lev LE, Patel RT, Maresh KJ, Guthikonda S, Granada J, DeLao T, et al. Aspirin and clopidogrel drug response in patients undergoing percutaneous coronary intervention. The role of dual drug resistance. J Am Coll Cardiol 2006;47:27–33. [CrossRef] [PubMed]
18. Gori AM, Marcucci R, Migliorini A, Valenti R, Moschi G, Paniccia R, et al. Incidence and clinical impact of dual nonresponsiveness to aspirin and clopidogrel in patients with drug-eluting stents. J Am Coll Cardiol 2008;52:734–9. [CrossRef] [PubMed]
19. Holmes DR, Kereiakes DJ, Garg S, Serruys PW, Dehmer GJ, Ellis SG, et al. Stent thrombosis. J Am Coll Cardiol 2010; 56(17): 1357-65. [CrossRef] [PubMed]
20. Roukoz H, Bavry AA, Sarkees ML, Mood GR, Kumbhani DJ, Rabbat MG, et al. Comprehensive meta-analysis on Drug-Eluting Stents versus Bare-Metal Stents during extended follow-up. Am J Med 2009; 122 (6): 581. e1-10. [PubMed]

21. Spaulding C, Daemen J, Boersma E, Cutlip DE, Serruys PW. A pooled analysis of data comparing Sirolimus-Eluting Stents with Bare-Metal Stents. N Engl J Med 2007;356: 989-97. [CrossRef] [PubMed]
22. Kastrati A, Mehilli J, Pache J, Kaiser C, Valgimigli M, Kelbæk H, et al. Analysis of 14 trials comparing sirolimus-eluting stents with bare-metal stents. N Engl J Med 2007;356: 1030-9. [CrossRef] [PubMed]
23. Doyle B, Rihal CS, O'Sullivan CJ, Lennon RJ, Wiste HJ, Bell M, et al. Outcomes of stent thrombosis and restenosis during extended follow-up of patients treated with bare-metal coronary stents. Circulation 2007;116:2391-8. [CrossRef] [PubMed]
24. Mauri L, Hsieh W, Massaro JM, Ho KKL, D'Agostino R and Cutlip DE. Stent thrombosis in randomized clinical trials of drug-eluting stents. N Engl J Med 2007;356:1020-9. [CrossRef] [PubMed]
25. Singh V, Patel A, Shaw ES, Martinezclark P, O'Neill WW. Very late bare metal stent thrombosis: Review of an often catastrophic outcome. Asia-Pacific Journal of Cardiology 2010;1.

KLINIČKE I ANGIOGRAFSKE KARAKTERISTIKE BOLESNIKA SA TROMBOZOM STENTA

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Tromboza stenta (TS) je posle perkutane koronarne intervencije (PCI) retka, ali potencijalno fatalna komplikacija, sa učestalošću od 1% do preko 5%. Faktori rizika za TS mogu da se podele na faktore koji su u vezi sa samim bolesnikom, sa procedurom, tipom stenta i karakteristikama lezije.

U studiju je uključeno 1055 bolesnika kojima je urađena PCI tokom 2009. i 2010. godine i koji su praćeni naredne dve godine. Bolesnici sa sigurnom TS čine ispitivanu (TS+), a bolesnici bez sigurne TS kontrolnu grupu (TS-). Sigurna TS definisana je prema kriterijumima ARC (Academic Research Consortium).

Sigurnu TS imalo je 23 bolesnika (2,2%). Rana TS zabeležena je kod 73,9%, kasna kod 8,7%, a vrlo kasna kod 17,4% bolesnika. Akutni infarkt miokarda sa ST elevacijom (STEMI) bio je najčešća klinička prezentacija (56,6% vs 20%, p<0,005) u ispitivanoj grupi. Prekid uzimanja aspirina i/ili clopidogrela (34,7%), kao i rezistencija na ove lekove (34,7%), NYHA klasa ≥2 (39,1% vs 17,1%, p<0,02) i manja ejekciona frakcija leve komore (42,3 vs 49,8, p<0,001) bili su glavni faktori TS koji se tiču samih bolesnika. Veći procenat stenoze lezija (92% vs 86%, p<0,05), veća prosečna dužina stenta (19,69 vs 17,01mm, p<0,05), mali dijametar stenta („potcenjena lezija") (21,7% vs 4,3%, < 0,01), manji pritisak insuflacije stenta (14,84 vs 16,02atm, p<0,05) i disekcija koronarne arterije (26,1% vs 8,6%, p<0,005) bili su signifikantni razlozi za nastanak TS. Kod bolesnika obe grupe primenjen je sličan tip stenta: BMS („bare metal stents) (69,6% vs 72,9%, NS) i DES („drug eluting stents") (30,4% vs 27,1%, NS).

Bolesnici sa STEMI, kao i oni sa oslabljenom sistolnom funkcijom leve komore, pod najvećim su rizikom za nastanak TS, u više od 2/3 slučajeva u prvih 30 dana nakon PCI (rana TS). Prekid uzimanja aspirina i/ili clopidogrela ili rezistencija na ove lekove dovode do TS (rana TS). Veći procenat stenoze lezija, veća dužina stenta, mali dijametar stenta („potcenjena lezija"), manji pritisak insuflacije i disekcija koronarne arterije su najčešći proceduralni razlozi za nastanak TS. Tip stenta (BMS i DES) nije značajno uticao na pojavu TS. *Acta Medica Medianae 2013;52(4):5-11.*

Ključne reči: *perkutana koronarna intervencija, tromboza stenta*

