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Russia, 101000, Moscow, Sverchkov per., 5
Moscow City Center of Interventional Cardioangiology
(for the Secretary of RSICA)
Phone: +7 (495) 624 96 36
President of RSICA: +7 (915) 301-00-67, +7 (985) 233-62-02
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International Journal
of Interventional Cardioangiology,
Sverchkov per., 5, Moscow, 101000, Russia.
Fax: (7 495) 624 67 33
e-mail: davidgi@mail.ru
elenita712@gmail.com

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Contents

Working Ability of Patients with a History of *Q*-Wave Acute Myocardial Infarction (AMI) Who Underwent Endovascular Myocardial Reperfusion in the Acute Period (Five-Year Follow-Up)

Volynsky Yu.D., Chernysheva I.E., Yarnykh E.V., Polumiskov V.Yu., Buraeva O.S., Koledinsky A.G., Iosseliani D.G.*

Moscow City Center of Interventional Cardioangiology, Moscow, Russia

The recovery of working capacity of patients after acute myocardial infarction is the most important medical as well as social and economic task. The presented data are suggestive of the leading role played by endovascular myocardial reperfusion performed within the shortest term after the onset of the disease, in the solution of this task.

Key words: *Acute myocardial infarction, endovascular reperfusion, working capacity.*

Understanding, diagnostics and treatment of acute myocardial infarction (AMI) have dramatically improved over the last decades. As a result, in-hospital mortality related to this disease decreased from 20–25% to 8–12% (1–4). This became possible, first of all, due to introduction of the following into the clinical practice: effective drugs for successful treatment of severe rhythm disturbances and acute heart failure; non-pharmacological methods for effective support of cardiac activity; and, which is particularly important, endovascular and surgical options for myocardial revascularization. Endovascular myocardial reperfusion performed within the first hours after the onset of disease took the prominent place in AMI treatment. In the majority of authors' opinion, in-hospital mortality and incidence of dangerous complications significantly decreased and long-term prognosis improved in particular due to these interventions (2–6).

Nevertheless, some authors are not as optimistic regarding advantages of endovascular methods for AMI treatment, considering that adequately chosen pharmacological therapy eliminates any considerable differences between conservative and endovascular treatment of this disease (7–8). The lack of randomized trials based on extensive comparison between conservative and endovascular treatment options in which the superiority of endovascular myocardial reperfusion over the pharmacological therapy would be clearly proved, is one of the reason for different opinions concerning the reperfusion therapy for AMI. Also, there is no unanimous opinion concerning the time limits when endovascular myocardial reperfusion should be performed, as well as advisability of pre-hospital thrombolysis as a first stage of treatment in patients who can undergo endovascular myocardial reperfusion in in-hospital settings.

Common evaluation criteria of immediate and long-term treatment results including rehabilitation stages and further working ability of the patients are required for objective assessment of the results of any treatment method. Improvement of patients' quality of life is one of the most important prerequisites for treatment efficacy, which is primarily determined by patient's ability to work or at least to provide self-care in order not to turn to relatives or social services.

Meanwhile, there are almost no reports in the literature regarding the working ability or working activity of AMI patients who underwent endovascular procedures. In turn, patient's working ability, especially during the follow-up, may serve as objective criterion for assessment of any treatment method results, including endovascular treatment of AMI patients. Investigators introduced the term "integrated

* *Address for correspondence:*
Dr. Yury Volynsky
Moscow City Center of Interventional Cardioangiology
Russia, 101000, Moscow, Svberchkov per., 5
Россия, 101000, Москва, Сверчков пер., д.5
E-mail: ydshmidt@rambler.ru
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sign" for multi-component assessment of the patient's condition summarizing specific sets of clinical parameters (Yu.D. Volynsky, A.I. Kurochkina, 1981, 1987).

In accordance with the Russian legislation, patients with the history of AMI are referred for Medical and Social Examination (MSE) with further obligatory annual re-examination, i.e. there are all prerequisites for considerably long (4–5 years) assessment of working ability in these patients over time. The importance of ensuring maximal objectivity of the study should be emphasized, considering that examination is performed by MSE employees rather than by attending physicians. These experts' resolution is based on multi-component investigation including assessment of the coronary blood flow and myocardial function, clinical state of the patient and concomitant pathology. Age, risk factors, bad habits, and adequacy of treatment response are taken into consideration during expert assessment. Integrated part of expertise is prognosis of disease outcome: a) favorable – with mild or moderate cardiovascular dysfunction, and b) unfavorable – with marked cardiovascular dysfunction and/or contraindications for certain types of labor.

Objective of our study was to assess the efficacy of endovascular myocardial reperfusion in AMI patients in terms of their working ability based on the long-term follow-up.

Clinical characteristics of patients and methods of the study

The study is based on the retrospective analysis of data from 671 patients with *Q*-wave AMI employed prior to the disease onset, taken from "DIMOL" automated database of the Moscow City Center of Interventional Cardioangiology, which currently contains necessary medical and social information from 115,000 patients, with 9,500 AMI patients among them. Follow-up covered the period from 2000 to 2012. As it was stated above, 671 eligible patients were selected for this study (one of the main inclusion criteria was long-term follow-up period (for at least 3 years) after conducted treatment). Also, according to inclusion criteria, the age of patients at the moment of Q-wave AMI onset should not have exceeded 55 years in males and 50 years in females.

The exclusion criteria were malignancies, congenital and rheumatic heart defects, complex rhythm and conduction disturbances, insulin-dependent diabetes mellitus, chronic lung diseases, hepatic and biliary diseases, gastrointestinal and urinary disorders, significant neurovascular pathology, i.e. patients with serious concomitant diseases were excluded. After discharge, all patients were initially examined at the Main Bureau for Medical and Social Examination (MBMSE) followed by annual re-examination of working ability at Cardiology Affiliate No.78 of MBMSE, or other Moscow MBMSE affiliates.

Patients enrolled in the study were assigned to two groups.

The main group included patients with *Q*-wave AMI (n = 491) who underwent successful endovascular myocardial reperfusion during the in-hospital stage in the Moscow City Center of Interventional Cardioangiology (balloon angioplasty and/or stenting of the infarct-related artery (IRA)).

The control group consisted of patients with *Q*-wave AMI (n = 180) who did not undergo endovascular or pharmacological myocardial reperfusion, or if these procedures were unsuccessful. They received standard drug therapy. Table 1 presents main clinical historical and laboratory data of the studied patients.

To convert the qualitative parameters used by MBMSE experts for assessment of patient's status into the quantitative parameters, we used numerical scale when scores are inversely related to patient's qualitative status. Relationship between patient's status score and disability group is presented below:

1 point – disability group 1;

2 points – disability group 2;

3 points – disability group 3;

4 points – working ability is restored (not considered as a disabled person).

After the disease, the outcome and prognosis for patients depend on both treatment efficacy and on how fast the treatment was initiated after the attack onset. It is especially important when it refers to restoration of organ or tissue function. In this case, it refers to restoration of impaired blood supply of a part of the myocardium. In fact, earlier treatment initiation from the angina onset in AMI patients is related to less significant myocardial damage, and, therefore, better immediate and long-term disease prognosis.

In connection with the abovementioned, it was important for us to study the prognosis and working ability of Q-wave AMI patients depending on intervals between the disease onset and conduction of treatment procedure. Hence, we nominally divided the main group of patients

into four subgroups. The first subgroup included patients who underwent endovascular myocardial reperfusion within the first 6 hours from the disease onset. The second subgroup consisted of patients who underwent the procedure 7–72 hours after the angina onset. The third subgroup included patients who had endovascular myocardial reperfusion on Days 4–14 from AMI onset. And finally, patients who underwent the procedure on Days 15–90 from AMI onset constituted the last fourth subgroup.

Statistics

STATISTICA for Windows 6.1 (StarSoft Inc., USA, 2006) was used for statistical analysis. Quantitative variables are presented as mean and standard deviation (M ± SD). When nonparametric data were compared, χ^2 test with Yates correction (χ^2) and two-sided Fisher's exact test (F) were used. When qualitative variables were compared to assess the mortality, unpaired Student's test was used, and Mann-Whitney test (U) was used for mortality structure analysis.

Results

The study demonstrated that in the majority of patients, the presence of *Q*-wave AMI in history has more or less negative impact on their working ability regardless of treatment methods which were used. During the first year after discharge, the majority of patients were assigned to disability group 2 or 3. These patients were regularly followed up and annually examined in the appropriate polyclinics during the further 5-year follow-up period. Results of these examinations are presented in Table 1. As evident from Table, 314 (64.8%) out of 491 patients from the main group, who underwent endovascular myocardial reperfusion at the various time points after AMI onset, were still employed five years after MI. In the control group, only 59 (32.8%) patients were still employed, i.e. approximately half as much. Moreover, 146 (29.7%) patients from the main group had increased working ability scores, i.e. they were transferred to lower disability group or disability was even canceled, whereas similar situation was observed in only 2 (1.11%) patients from the control group.

Similar patterns were also detected when studying the working ability of patients over time separately for anterior and posterior left ventricular localization of myocardial infarction. However, the most important fact, as evidenced by data presented in Table 1, is: starting from Year 1 and throughout the observation period a certain difference was observed in changes of the working ability parameter between those who received and those who did not undergo endovascular treatment. In particular, this difference among the patients with anterior *Q*-wave AMI was 0.21 points during the 1st year, and by the 5th year it increased to 0.66 points ($p < 0.01$). Increase of the working ability level in patients with posterior AMI was even more significant over time: the difference was 0.17 points at Follow-up Year 1, whereas in 5 years this parameter reached 0.92 points ($p < 0.001$).

In turn, as is evident from data presented in Table 1 and Figure 1, almost no tendency towards improvement of working ability was observed in patients from the control group who received drug treatment alone, and at the follow-up endpoint the working ability parameter in patients with AMI localized at the posterior wall of the left ventricle was even lower than during Follow-up Year 1.

It also should be noted that in five years worsening of the clinical condition accompanied by decrease of the working ability was significantly less common in patients who underwent endovascular treatment as opposed to patients from the control group (6.31% and 13.9%, respectively). The difference between groups was significant ($p < 0.01$).

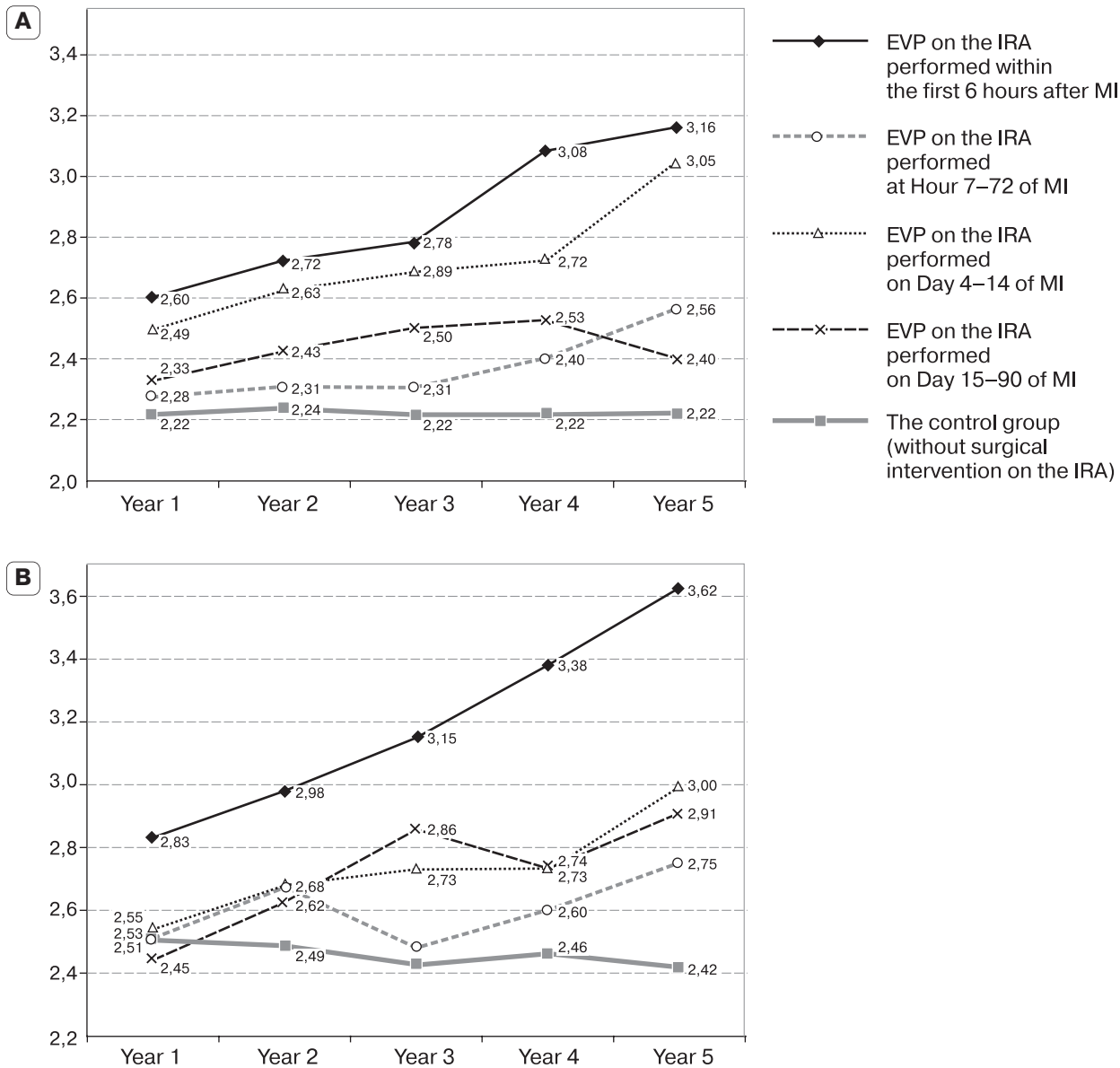
Moreover, conducted study clearly demonstrated a significant relation between successful restoration of working ability after AMI and the terms of conducting endovascular myocardial reperfusion. Namely, the sooner reperfusion is performed, the better are working ability parameters. Thus, in patients with myocardial reperfusion performed within the first six hours from the disease onset, the highest working ability score was reported afterwards (3.44); meanwhile, in patients who underwent the procedure later (i.e. 7–72 hours after the disease onset) this parameter was lower (2.61) ($p < 0.01$). At the same time, immediate and long-term results of working ability in patients who underwent myocardial reperfusion during the subacute period (i.e. on Days 4–14 from MI onset) were significantly better than in the previous subgroup. Higher total mean working ability score in this subgroup (3.03; $p < 0.01$) confirms this observation.

The lowest working ability scores were observed in a group of patients who did not undergo endovascular myocardial reperfusion. Mean score in this arm was 2.31.

Table 1. Social characteristic and working ability over time in patients with a history of acute myocardial infarction (AMI) in the working age (n = 671)

Groups of patients		Social characteristic		Working ability after myocardial infarction (MI) over time								
		Age when MI occurred (years)	Males, n (%)	Year 1 (score)	Year 2 (score)	Year 3 (score)	Year 4 (score)	Year 5 (score)	Employed at the follow-up endpoint, n (%)	Out of them, intellectual labor, n (%)	Transferred to higher disability group or not considered as a disabled person, n (%)	Transferred to lower disability group due to cardiovascular disease (CVD), n (%)
MI patients from the **main group**	Overall in the group n = 491	47,91	460 (93,7)	2,55*	2,69*	2,76*	2,89*	3,10*	314 (64,8)*	235 (47,9)*	146 (29,7)*	31 (6,31)*
	Q-wave anterior MI n = 263 (53,6%)	47,77	244 (92,8)	2,43*	2,54*	2,59*	2,73*	2,88*	145 (55,1)*	120 (45,6)*	64 (24,3)*	19 (7,22)
	Q-wave posterior MI n = 228 (46,4%)	48,08	216 (94,7)	2,68*	2,87*	2,95*	3,07*	3,34*	169 (74,1)*	115 (50,4)*	82 (36,0)*	12 (5,26)*
1st subgroup EVP within the first 6 hours of AMI	Overall in the subgroup n = 230 (100%)	47,88	215 (93,5)	2,72	2,86	2,99	3,25	3,44	177 (72,0)	114 (49,6)	84 (36,5)	11 (4,78)
	Q-wave anterior MI n = 103 (41,3%)	47,73	96 (93,2)	2,60	2,72	2,78	3,08	3,16	69 (67,0)	51 (49,5)	30 (30,0)	8 (8,0)
	Q-wave posterior MI n = 127 (51,0%)	48,01	119 (93,7)	2,83	2,98	3,15	3,38	3,62	108 (85,0)	63 (49,6)	54 (43,9)	3 (2,44)
2nd subgroup EVP at Hour 7–72 of AMI	Overall in the subgroup n = 119 (100%)	48,42	114 (95,8)	2,34**	2,41**	2,35**	2,45**	2,61**	53 (44,5)**	54 (45,4)	17 (14,3)**	13 (10,9)
	Q-wave anterior MI n = 87 (65,9%)	48,28	82 (94,3)	2,28**	2,31**	2,31**	2,40**	2,56	35 (40,2)**	34 (39,1)	10 (12,8)**	8 (10,1)
	Q-wave posterior MI n = 32 (24,2%)	48,81	32 (100)	2,53**	2,68**	2,48**	2,60**	2,75**	18 (56,3)**	20 (62,5)	7 (24,1)**	5 (16,7)
3rd subgroup EVP on Day 4–14 of AMI	Overall in the subgroup n = 74 (100%)	47,32	67 (90,5)	2,51**	2,65**	2,71**	2,72**	3,03**	44 (59,5)**	33 (44,6)	27 (36,5)	4 (5,41)
	Q-wave anterior MI n = 43 (38,4%)	47,14	38 (88,4)	2,49**	2,63	2,69	2,72**	3,05	25 (58,1)	18 (41,9)	17 (40,5)**	1 (2,38)
	Q-wave posterior MI n = 31 (27,7%)	47,58	29 (93,5)	2,55**	2,68**	2,73**	2,73**	3,00**	19 (61,3)**	15 (48,4)	10 (33,3)	3 (10,0)
4th subgroup EVP on Day 15–90 of AMI	Overall in the subgroup n = 68 (100%)	47,79	64 (94,1)	2,35**	2,65**	2,70**	2,64**	2,67**	40 (58,8)	34 (50,0)	18 (26,5)**	3 (4,41)
	Q-wave anterior MI n = 30 (34,5%)	47,37	28 (93,3)	2,33**	2,43**	2,50**	2,53**	2,40**	16 (53,3)**	17 (56,7)	7 (24,1)	2 (7,14)
	Q-wave posterior MI n = 38 (43,7%)	48,13	36 (94,7)	2,45**	2,82	2,86**	2,74**	2,91**	24 (63,2)**	17 (44,7)	11 (30,6)	1 (2,77)
MI patients **from the control group**	Overall in the group n = 180	47,18	170 (94,4)	2,35	2,36	2,32	2,33	2,31	59 (32,8)	61 (33,9)	2 (1,11)	25 (13,9)
	Q-wave anterior MI n = 96 (53,3%)	46,79	90 (93,8)	2,22**	2,24**	2,22**	2,22**	2,22**	27 (28,1)**	31 (32,3)**	0 (0,00)**	7 (7,29)
	Q-wave posterior MI n = 84 (46,7%)	47,63	80 (95,2)	2,51**	2,49**	2,43**	2,46**	2,42**	32 (38,1)**	30 (35,7)**	2 (2,38)**	18 (21,4)**

Notes: * – significant differences between the main group and the control group ($p < 0.01$); ** – significant differences from the 1st subgroup ($p < 0.01$)



Working ability in patients after primary MI over time. A – *Q*-wave anterior MI. B – *Q*-wave posterior MI.

Therefore, conducted study demonstrated that, firstly, the degree of working ability loss in *Q*-wave AMI patients who received endovascular myocardial reperfusion was significantly lower as compared with patients who did not undergo endovascular procedure (EVP). Moreover, these differences became greater over the years and in 64.8% of patients treated via endovascular method working ability was preserved or restored by Follow-up Year 5, while such result was observed only in 32.8% of AMI patients treated without EVP. And, secondly, the study also demonstrated a certain correlation between the efficacy of endovascular reperfusion in terms of working ability restoration, and the terms of its conduction regarding the disease onset.

Discussion

When assessing the working ability of patients who suffered from any kind of disease, it is necessary to conduct complex analysis of clinical and functional state of these patients when making a decision on their working ability, of used treatment and rehabilitation methods.

As for treatment of acute myocardial infarction, nowadays endovascular myocardial reperfusion is actively used in the repertoire of applicable techniques in many treatment facilities besides commonly accepted conservative (pharmacological) options. Mentioned technique is rather widely used, and the global experience of its use amounts to many hundreds of thousands of cases.

Table 2. Clinical and instrumental parameters in patients with the history of AMI in the working age at end-point of the follow-up (n = 671)

Groups of patients		Post-AMI clinical status						Structure of mortality	
		Postinf. aneurysm n (%)	Complex arrhythmia n (%)	CHF ⩾ FC2 n (%)	Recurrent MI n (%)	LV EF (%)	Positive stress test n (%)	Mortality within the first 5 years n (%)	Deaths from CVD within the first 5 years n (%)
MI patients from the **main group**	Overall in the group n = 491	126 (25,7)*	77 (15,7)*	160 (32,6)*	48 (9,77)*	52,29*	106 (21,6)*	22 (4,48)*	19 (86,4)
	Q-wave anterior MI n = 263 (53,6%)	121 (46,0)*	51 (19,4)*	118 (44,9)*	24 (9,13)*	49,13*	62 (23,6)*	13 (4,94)*	13 (100,0)
	Q-wave posterior MI n = 228 (46,4%)	5 (0,88)*	26 (11,4)*	42 (18,4)*	24 (10,5)*	55,91*	44 (19,3)*	9 (3,95)*	6 (66,7)
1st subgroup EVP within the first 6 hours of AMI	Overall in the subgroup n = 230 (100%)	30 (13,0)	32 (13,9)	48 (20,9)	14 (6,09)	56,24	27 (11,7)	7 (3,04)	6 (85,7)
	Q-wave anterior MI n = 103 (41,3%)	30 (29,1)	18 (17,5)	32 (31,1)	6 (5,8)	54,04	14 (13,6)	3 (3,26)	3 (100)
	Q-wave posterior MI n = 127 (51,0%)	0 (0)	14 (11,0)	16 (12,6)	8 (6,3)	58,02	13 (10,2)	4 (3,20)	3 (75,0)
2nd subgroup EVP at Hour 7–72 of AMI	Overall in the subgroup n = 119 (100%)	60 (50,4)**	27 (22,7)**	71 (59,7)**	14 (11,8)**	44,42**	45 (37,8)**	12 (10,1)**	11 (91,7)
	Q-wave anterior MI n = 87 (65,9%)	59 (67,8)**	22 (25,3)**	57 (65,5)**	9 (10,3)	42,05**	30 (34,9)**	9 (11,8)**	9 (100)
	Q-wave posterior MI n = 32 (24,2%)	1 (3,10)	5 (15,6)	14 (43,8)**	5 (15,6)	50,84**	15 (46,9)**	3 (10,3)**	2 (66,7)
3rd subgroup EVP on Day 4–14 of AMI	Overall in the subgroup n = 74 (100%)	18 (24,3)	9 (12,2)	23 (31,1)	9 (12,2)	51,72	22 (29,7)**	0 (0,00)	0 (0,00)
	Q-wave anterior MI n = 43 (38,4%)	16 (37,2)	4 (9,3)	15 (34,9)	5 (11,6)	50,95**	12 (27,9)**	0 (0,00)	0 (0,00)
	Q-wave posterior MI n = 31 (27,7%)	2 (6,5)	5 (16,1)	8 (25,8)	4 (12,9)	52,77**	10 (32,3)	0 (0,00)	0 (0,00)
4th subgroup EVP on Day 15–90 of AMI	Overall in the subgroup n = 68 (100%)	18 (26,5)**	9 (13,2)	18 (26,5)	11 (16,2)**	53,01**	12 (17,6)**	3 (4,41)	2 (66,7)
	Q-wave anterior MI n = 30 (34,5%)	16 (53,3)**	7 (23,3)	14 (46,7)	4 (13,3)	49,67**	6 (20,0)	1 (3,80)	1 (100)
	Q-wave posterior MI n = 38 (43,7%)	2 (5,3)	2 (5,3)	4 (10,5)	7 (18,4)**	55,63**	6 (15,8)	2 (5,40)	1 (50,0)
MI patients **from the control group**	Overall in the group n = 180	65 (36,1)	73 (40,5)	108 (60,0)	69 (33,7)	45,54	132 (73,3)	25 (13,0)	23 (92,0)
	Q-wave anterior MI n = 96 (53,3%)	55 (57,3)**	49 (51,0)**	67 (69,8)**	33 (34,4)**	41,26**	79 (79,6)**	17 (17,9)**	16 (94,1)
	Q-wave posterior MI n = 84 (46,7%)	10 (11,9)**	24 (28,6)**	41 (48,6)**	26 (31,0)**	48,96**	53 (63,0)**	8 (9,60)**	7 (87,5)

Notes: * – significant difference between the main group and the control group with $p < 0,05$. ** – significant difference with Subgroup 1 with $p < 0,05$.

Meanwhile, there are almost no reports in the literature dedicated to comparative analysis of the working ability among patients who underwent endovascular myocardial reperfusion and received routine conservative (pharmacological) therapy. We managed to find only one report in which the authors also investigated the working ability along with survival rate to assess the efficacy of endovascular procedures and systemic thrombolysis in AMI treatment (9).

Analyzing working ability restoration over time in our studied patients, it should be noted that conducted study revealed a significant advantage of endovascular reperfusion therapy over conservative treatment of AMI. This is evidenced by changes in basic clinical and functional parameters over time, characterizing the course and outcome of the disease. As can be seen from Table 2 data, post-infarction left ventricular aneurism developed significantly less frequently in a group of patients with reperfusion therapy as compared to a group of subjects who did not receive the similar treatment (25.7% and 36.1%, respectively; $p < 0.01$); complex heart rhythm disturbances were observed only in 15.7% of cases in the reperfusion group, while in the control group they were detected in 40.5% of patients ($p < 0.01$); in the mid-term period repeated myocardial infarction was observed in 9.77% of patients from the main group and in 31.5% of patients from the other group, respectively ($p < 0.01$). Stress test, which rather objectively and accurately reflects a functional cardiac state, including cardiac vascularization, in CHD patients, was positive in 29.8% of cases in the main group,and in 57.5% of patients from the control group ($p < 0.01$). The groups also differed in the functional state of the left ventricle. Cardiac pump function (left ventricular ejection fraction, LVEF) in the main group was insignificantly reduced (mean value was 52.29 ± 5.4%), while in the other group its reduction was significant (45.54 ± 4.6%) ($p < 0.001$).

Here it should be noted that when AMI was localized at the posterior wall of the left ventricle, LV ejection fraction was not as significantly reduced as during anterior AMI (55.91 ± 6.3% and 49.13 ± 6.8% in the main group, and 48.96 ± 7.4% and 41.26 ± 7.9% in the control group, respectively). Clinical signs of functional class II heart failure in the main group were also observed significantly more rarely (32.6%) than in the control group (60.0%). And finally, there also were significant ($p < 0.01$) and fundamental differences between the groups in such important parameter as mortality. Overall mortality in the main group was 4.48% during the 5-year follow-up, whereas its value in the control group was 13.0%, i.e. more than 2.9-fold higher.

Therefore, conducted study demonstrated that clinical and functional parameters improved in the mid-term period after acute myocardial infarction in both groups of patients with Q-wave AMI. However, degree of this improvement in different groups varied. Thus, better immediate and long-term disease prognosis was observed in a group of patients with endovascular myocardial reperfusion. And, most notably, the same pattern of changes in the level of working ability was detected in the studied groups. Thus, in patients from the main group this parameter after 5 years of the follow-up increased by 21.6% regarding the level registered in a year after AMI. And at the follow-up endpoint, the working ability parameter in a group with endovascular blood flow restoration in the IRA was 34.2% higher than in a group of patients treated according to the routine conservative management practice (Table 1).

The study also demonstrated that patients with anterior AMI have worse clinical status and working ability parameters than patients with AMI localized at the posterior wall of the left ventricle, regardless of what treatment method was used. In particular, the working ability parameter in patients with anterior and posterior localization of necrosis focus was 2.88 and 3.34 points in the main group, and 2.22 and 2.46 points in the control group, respectively ($p < 0.05$).

Conclusions

1. Successful myocardial revascularization in Q-wave acute myocardial infarction using coronary angioplasty of the infarct-related artery has more pronounced positive effect on preservation of working ability of the patients as compared with conventional drug therapy.

2. The most positive effect on the clinical course of acute myocardial infarction, preservation and recovery of working ability is observed if coronary angioplasty is performed within the first 6 hours after disease onset.

3. Favorable but less pronounced positive effect on myocardial infarction course and restoration of working ability of the patients is observed if coronary angioplasty of the infarct-related artery is performed on Days 4–14 from the disease onset.

4. The least positive effect is observed if coronary angioplasty is performed within the period from 7 to 72 hours after AMI onset.

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Successful Endovascular Treatment of Multiple Coronary Occlusions in Acute Myocardial Infarction Complicated by Cardiogenic Shock and Clinical Death (case report)

Simonov O.V., Vasiliev P.S., Ozolinya E.Yu., Koledinsky A.G., Kovalchuk I.A., Chernysheva I.E., Iosseliani D.G.*

Moscow City Centre of Interventional Cardioangiology, Moscow, Russian Federation

Cardiogenic shock remains one of the dangerous complications of acute myocardial infarction with in-hospital mortality rate of up to 80%. It is also known that the course of this disease considerably depends on the state of coronary circulation, and in case of its multiple stenotic-occlusive lesions mortality can reach 100%. A case of successful treatment of a female patient with Q-wave anterior acute myocardial infarction complicated by cardiogenic shock and clinical death is described in this article. The female patient underwent complete endovascular myocardial revascularization which included recanalization and stenting of the left anterior descending artery (LAD), right coronary artery (RCA) and obtuse marginal branch (OMB) of the left circumflex artery (LCX). Besides, cytoprotective agent Mexicor was administered as bolus into the LAD immediately after its recanalization to prevent myocardial reperfusion injury. Urgent procedure was performed during continuous resuscitation procedures which included closed-chest cardiac massage, intra-aortic balloon pumping (IABP) and mechanical lung ventilation (MLV).

Key words: *acute myocardial infarction, cardiogenic shock, multivessel disease, complete revascularization.*

List of abbreviations

IABP – intra-aortic balloon pumping
MLV – mechanical lung ventilation
IRA – infarct-related artery
AMI – acute myocardial infarction
PCI – percutaneous coronary intervention
LAD – anterior descending artery
LCX – circumflex artery
RCA – right coronary artery
OMB – obtuse marginal branch

Introduction

Cardiogenic shock is observed in 5–10% of patients with Q-wave acute myocardial infarction (AMI) and is one of the most common causes of death in this disease (1, 2, 5, 6, 10). It is generally accepted that cardiogenic shock is a clinical condition with systolic blood pressure lower than 90 mm Hg for more than 30 minutes, or a state requiring hemodynamic support to maintain the pressure higher than 90 mm Hg; the clinical signs of shock are also observed, such as cold moist limbs, cyanosis, shallow frequent breathing, sinus tachycardia, oliguria (diuresis less than 30 mL/hour) and depressed consciousness (1, 2, 3, 5). As a rule, the main cause of this dangerous AMI complication is extensive myocardial lesion sometimes including the combination of necrotized myocardium and scarry changes (15). Frequently it is accompanied by severe coronary lesions.

During the acute phase of myocardial infarction, systolic dysfunction of the left ventricle (LV), as we already noted, is caused by combination of necrotized, ischemic and also scarry myocardium (2). It is considered that cardiogenic shock develops when LV myocardial dysfunction exceeds 50% (6). Risk factors of cardiogenic shock in AMI patients are: a history of myocardial infarction; a history of heart failure; anterior myocardial infarction; mild or absent compensatory hyperkinesia of the left ventricular wall opposite to the wall affected by infarction; complete occlusion of the infarct-related artery; multivessel coronary disease with chronic occlusions of other coronary arteries; concomitant diabetes mellitus (2, 7).

According to some authors (Werdan K. et al.), cardiogenic shock is a systemic reaction of the body involving all patient's organs due to blood flow and microcirculation impairment, which is confirmed, in particular, by the presence of lactic acidosis (3, 5). The presence of acute renal failure in such patients requiring renal replace-

* *Address for correspondence:*
Dr. Oleg Simonov
Moscow City Center of Interventional Cardioangiology
Russia, 101000, Moscow, Sverchkov per., 5
E-mail: dr.sov@mail.ru
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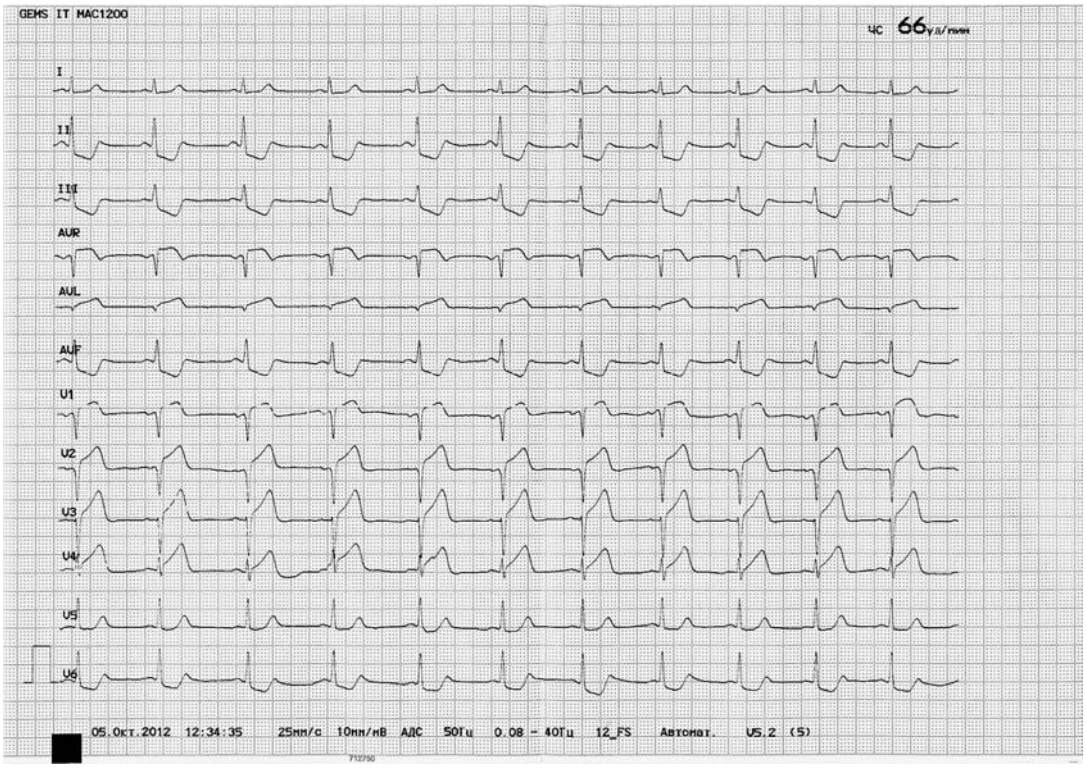

Figure 1. ECG on admission to the in-patient department.

ment therapy, which develops in approximately 12% of patients with cardiogenic shock, also indicates this fact (8, 9). In-hospital mortality of patients with cardiogenic shock during conservative therapy is 70–90% (1, 2, 6, 10), and is reduced to 40–50% when using urgent endovascular myocardial reperfusion and methods of artificial circulatory support (4, 10). Bataille Y. et al. (7) determined that in-hospital mortality caused by cardiogenic shock depends to a large extent on the state of coronary circulation. For example, 30-day mortality in patients without chronic occlusions of the coronary arteries was 40.2%, in case of chronic occlusion of one artery it was 65.6% and 100% in chronic occlusion of two and more arteries ($p < 0.0001$). One or a few of the following factors can cause the death in cardiogenic shock: unstable hemodynamics, multiple organ dysfunction syndrome (MODS), systemic inflammatory response syndrome (SIRS) (3, 5).

We present a case of successful treatment of a female patient with Q-wave AMI with multiple occlusions of the coronary arteries, cardiogenic shock and clinical death.

Case presentation

A female 59-year-old patient A. suffered from angina (2^{d} functional class (FC)) for 3 years, her treatment was irregular. On October 5, 2012 at 09:00, the patient suddenly developed intense pressing chest pain, weakness, nausea and vomiting (twice). The patient called the ambulance which diagnosed peracute phase of ST-elevation myocardial infarction on the anterior wall of the left ventricle. The following therapy was started by the ambulance unit: 10 mg of morphine; 0.05 mg of fentanyl; 300 mg of clopidogrel; heparin at a dose of 4,000 U; 7,000 U of tenecteplase (Metalyse); dopamine at a dose of 10 μg/kg/minute. The patient was admitted to the Resuscitation and Intensive Care Unit of the Moscow City Center of Interventional Cardioangiology at 12:31 diagnosed with Q-wave AMI of the anterior wall of the left ventricle complicated by cardiogenic shock. Duration of acute condition was 3.5 hours. The patient's condition was extremely severe. She was in stupor. The skin was sallow, cold and moist. The breath was shallow with a rate of 24 per minute. On lung auscultation there was a moderate amount of moist rales bilaterally. SpO_2 = 95%. Hemodynamics was unstable; BP was 90/50 mm Hg despite dopamine infusion at a rate of 10 μg/kg/minute. HR was 70 beats per minute. Heart sounds were muffled, no murmurs were heard. Pulsation on the peripheral arteries was decreased. She had oliguria.

ECG revealed: sinus rhythm with a heart rate of 66 beats per minute; QS waves in leads V1 V2, low R waves in V3; monophasic elevation of ST segment up to 3 mm was seen in leads V1 V4 and reciprocal depression of ST segment up to 3 mm in leads II, III, aVF, V5 V6 (Fig. 1).

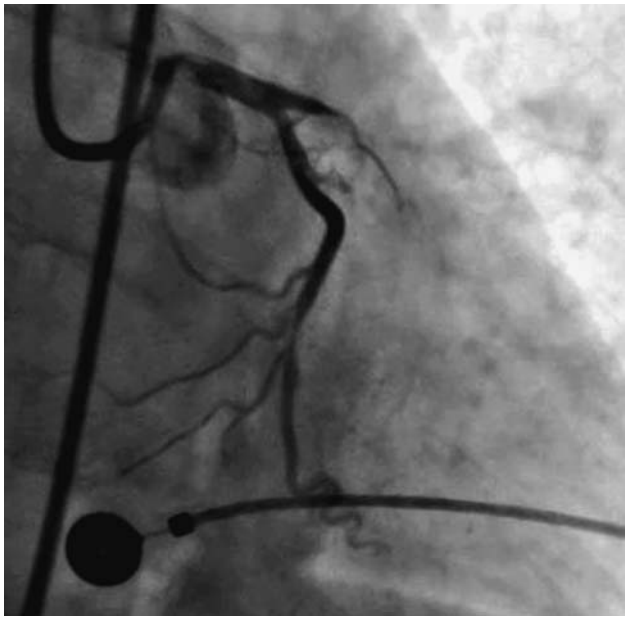

Figure 2. Coronary angiography of the LCA at the baseline. LAD was occluded in the proximal segment; antegrade TIMI 0 blood flow was observed; no intrasystem collateral filling of the distal vessels was detected. LCX was critically stenosed in the distal segment. OMB was occluded in the proximal segment.

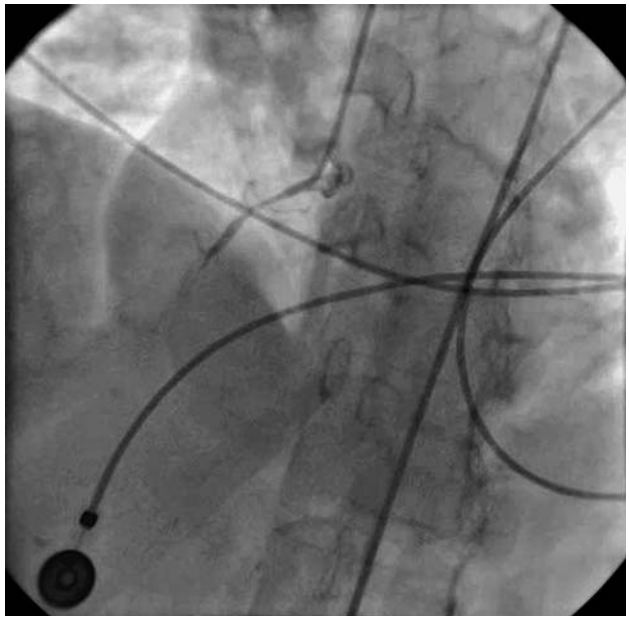

Figure 3. Coronary angiography of the RCA at the baseline. Occlusion of the RCA in the middle segment; antegrade TIMI 0 blood flow; no intrasystem collateral filling of the distal vessels. The hands of the resuscitator conducting closed-chest cardiac massage can be seen on the image.

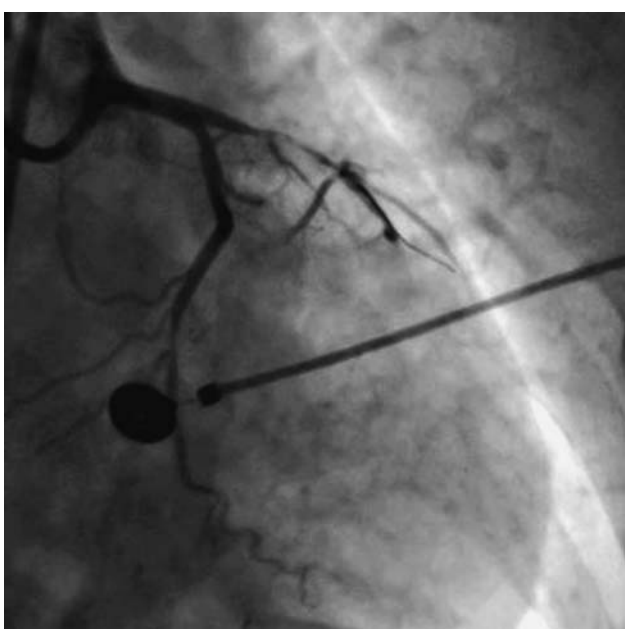

Figure 4. Mechanical recanalization of the LAD.

Transthoracic echocardiography revealed akinesia of all apical and middle segments of the LV, LV ejection fraction was 20%. The analysis of blood acid-base balance showed significant metabolic acidosis (pH = 7.24; BE = –12; Lac = 6.2 mmol/L).

The patient's state progressively worsened; at 12:58 depressed consciousness and breathing were detected; cardiac monitor recorded idioventricular rhythm, transforming into asystole; BP and pulsation on the main arteries could not be detected. The following resuscitation procedures were started immediately: intubation of trachea and forced mechanical lung ventilation, closed-chest cardiac massage, intravenous administration of catecholamines (dobutamine, adrenaline), atropine, neuroprotectors and sedative agents, correction of metabolic acidosis.

While continuing resuscitation procedures, the patient was urgently transferred to the Department of Endovascular Diagnosis and Treatment Methods. For hemodynamic support, balloon was placed into descending aorta and intra-aortic balloon pumping (IABP) was started. However, due to its low efficacy in the clinical death settings, all diagnostic and treatment procedures were performed together with closed-chest cardiac massage. Considering the terminal state of the patient, left ventriculography was not conducted. Selective coronary angiography revealed acute occlusion of the LAD in the proximal segment, chronic occlusions of the OMB in the proximal segment and of the RCA in the middle segment, critical stenosis of the distal segment of the LCX (Fig. 2, 3).

After diagnostic coronary angiography, endovascular procedure on the infarct-related artery (IRA) was performed: mechanical recanalization, intracoronary administration (through a microcatheter) of metabolic cytoprotective agent Mexicor at a dose of 100 mg, balloon angioplasty and proximal segment stenting of the LAD via bare-metal stent 2.75 × 28 mm in size (Fig. 4–6). Cardiac monitor detected episodes of idioventricular rhythm. Considering that, on the one hand, the patient's condition slightly improved, and on the other hand,

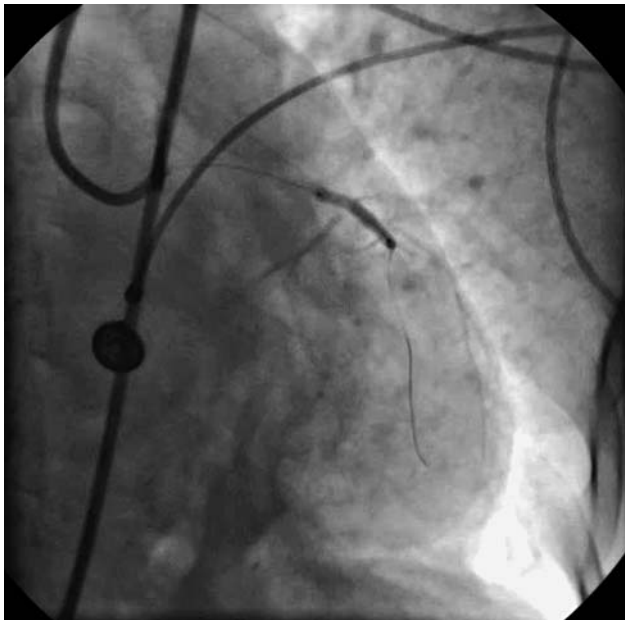

Figure 5. Implantation of 2.75 × 28 mm stent in the proximal segment of the LAD.

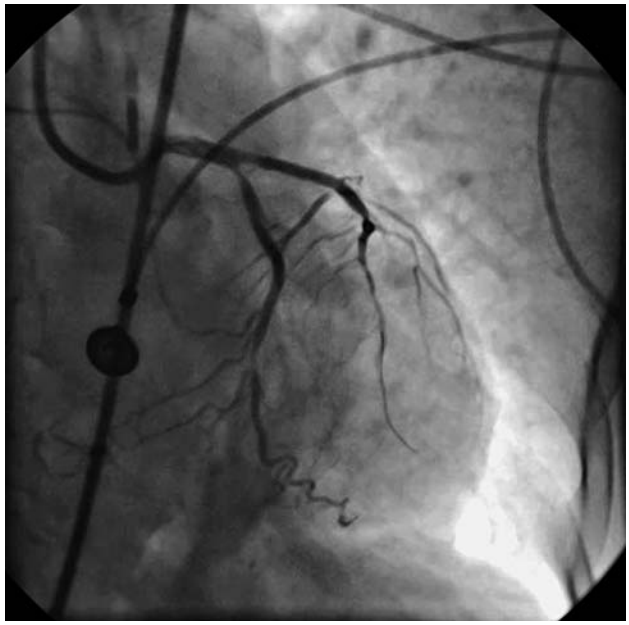

Figure 6. Angiogram of the LCA after mechanical recanalization, transluminal angioplasty and stenting of the proximal segment of the LAD.

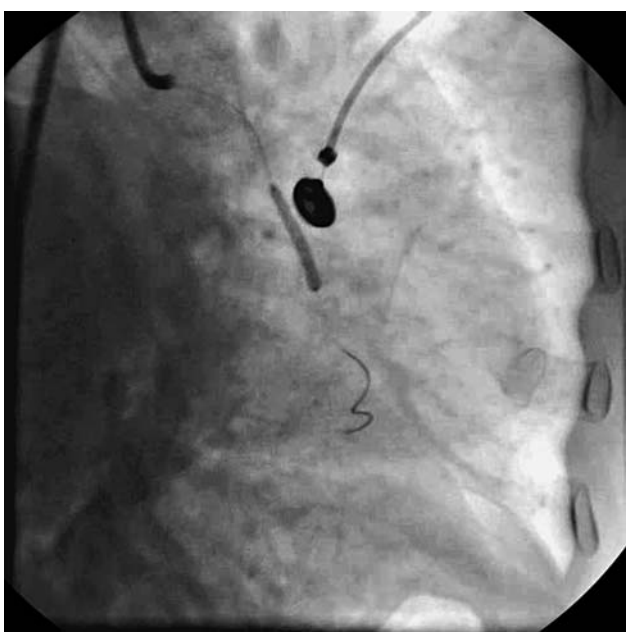

Figure 7. Implantation of 2.75 × 23 mm stent in the proximal segment of the OMB.

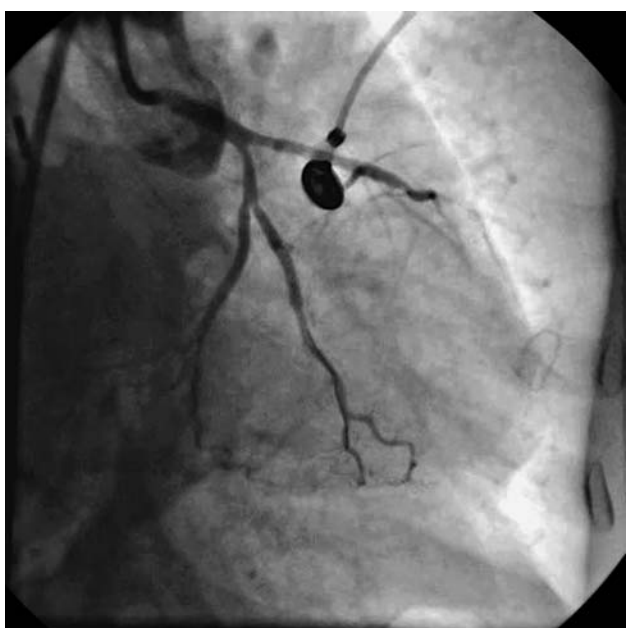

Figure 8. Angiogram of the LCA after mechanical recanalization, transluminal angioplasty and stenting of the proximal segment of the OMB.

taking into account severe lesions of other coronary arteries which could further worsen the clinical course of disease, it was decided to perform complete endovascular myocardial revascularization. The following procedures were performed: mechanical recanalization, balloon angioplasty and stenting of the OMB using bare metal stent 2.75 × 23 mm in size (Fig. 7, 8); direct stenting of the distal LCX segment using bare-metal stent 3 × 18 mm in size (Fig. 9); mechanical recanalization, balloon angioplasty and stenting of the middle segment of the RCA using drug-eluting stent 2.25 × 28 mm in size (Fig. 11, 12). Control coronary angiograms of both left and right coronary arteries demonstrated an optimal result of the procedures (Fig. 9, 10, 12).

After complete myocardial revascularization, accelerated nodular rhythm with a rate of 120/minute was registered; closed-chest cardiac massage was stopped. Duration of clinical death was about 40 minutes. The signs of cardiogenic shock, cerebral and respiratory failure persisted in the postoperative period; therefore, IABP, MLV, pharmacologic sedation, inotropic and vasopressor support, stimulation of diuresis, antiaggregant and anticoagulant therapy

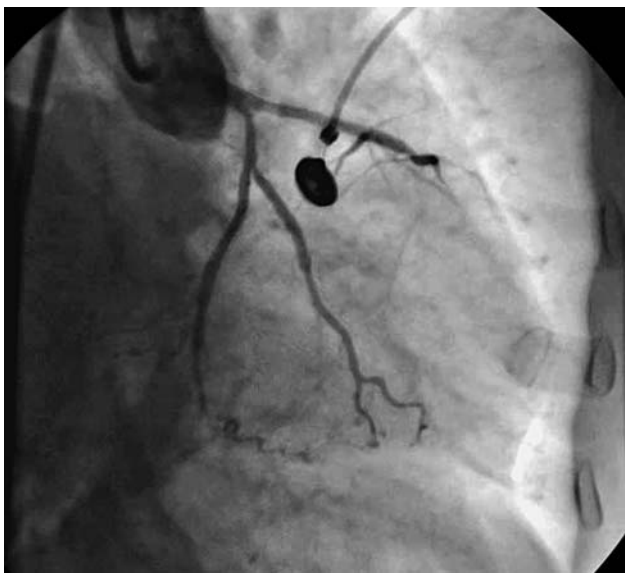

Figure 9. Angiogram of the LCA after direct stenting of the distal segment of the LCX (final result).

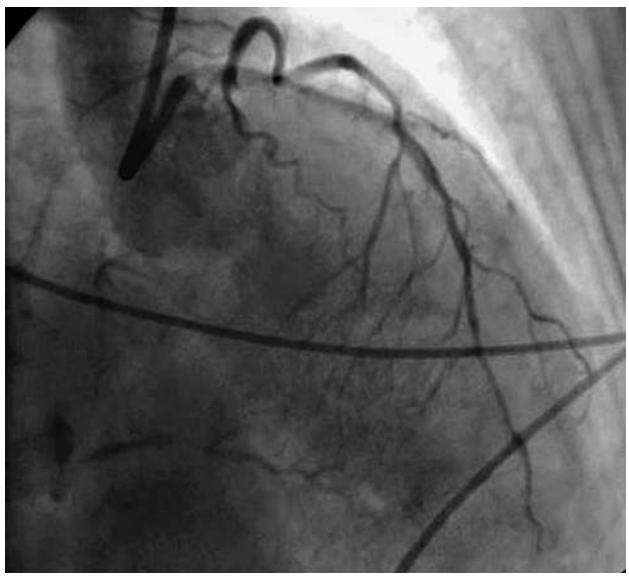

Figure 10. Angiogram of the LCA. Final result of the above-mentioned endovascular procedures in another projection. Collaterals into the system of the RCA are observed.

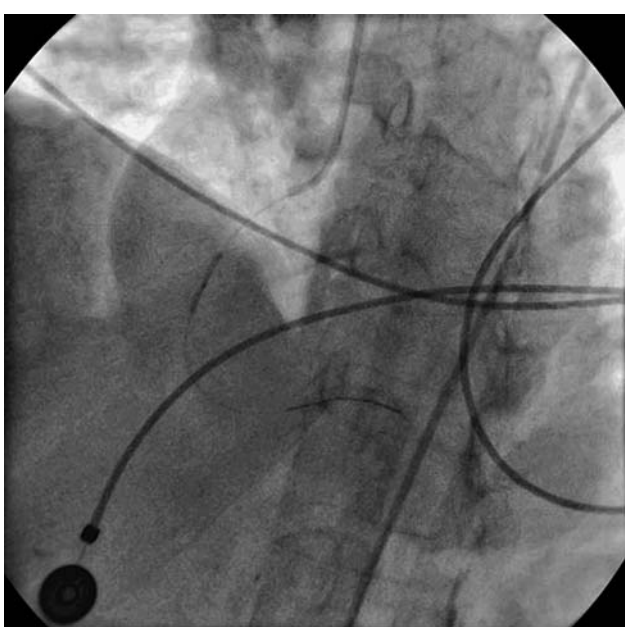

Figure 11. Implantation of 2.25 × 28 mm stent in the middle segment of the RCA.

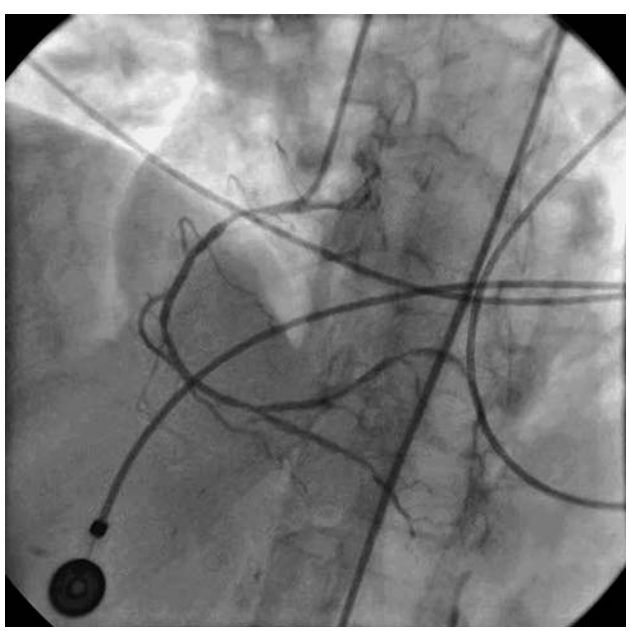

Figure 12. Angiogram of the RCA after mechanical recanalization, transluminal angioplasty and stenting of the middle segment of the RCA.

were conducted. As renal function improved after the procedure, renal replacement therapy was not required. On Day 4 hemodynamic parameters improved, consciousness and unassisted breathing completely restored; due to this, MLV and IABP were stopped. The patient was transferred to the Cardiology Department in a stable condition. Control echocardiography revealed improvement of global and segmental LV contractility; LV ejection fraction increased to 39%, dimensions of cardiac cavities remained within the normal range (end-diastolic dimension (EDD) 4.5 cm, end-systolic dimension (ESD) 3.3 cm, end-diastolic volume (EDV) 88 cm^3, end-systolic volume (ESV) 48 cm^3). On Day 22, the patient was discharged from the in-patient department in satisfactory condition, without neurologic deficiency.

Experience of our Centre in the treatment of patients with AMI complicated by severe left ventricular failure or cardiogenic shock demonstrates that for successful disease outcome it is important to start the therapy, and foremost, endovascular myocardial reperfusion, as early as possible. This includes blood flow restoration both in the infarct-related artery and, which

is extremely important, in other stenosed coronary arteries. In order to prevent myocardial reperfusion injury, we consider it reasonable to administer such metabolic cytoprotective agents as Mexicor or Neoton by bolus immediately after recanalization of the infarct-related artery, which, according to our observation, rather effectively protect myocardium from reperfusion injury (11, 13). All treatment procedures in cardiogenic shock should be started immediately and must be conducted parallel to diagnostic procedures (5). A whole set of effective therapeutic and diagnostic methods for treatment of cardiogenic shock was used in this clinical case. In a few words, when characterizing each of these methods, it should be noted that pre-hospital systemic thrombolytic therapy in cardiogenic shock is effective in approximately 40–50% of patients (1, 2). In this case the procedure was ineffective; nevertheless, we think that it should be used in all patients except for those in whom it is contraindicated. Indeed, it is well known that pre-hospital thrombolysis is a method which can restore blood flow in the infarct-related artery within the earliest terms and, thereby, protect myocardium from death.

Endovascular treatment makes it possible to achieve the most optimal myocardial reperfusion by means of blood flow restoration in the occluded IRA (5, 6). Good result of PCI is the most important predictor of survival in patients with cardiogenic shock (6). Thus, Subban V. et al. demonstrated that survival rate in patients with good result of the PCI on the IRA within 30 days constitutes 80% and 9.6% in case of unsatisfactory result (6). If there are occlusions or significant stenoses of other coronary arteries, the decision on treatment tactics is usually made individually in every specific case (5). We decided to conduct simultaneous complete endovascular revascularization, and this tactics justified itself.

It is known that after blood flow restoration in the infarct-related artery, cardiomyocytes continue to die because of their reperfusion injury. Metabolic cytoprotective agents, administered into the recanalized IRA, increase the efficacy of oxygen utilization by the cells in the ischemic settings, reduce reperfusion injury of the cardiomyocytes, make it possible to salvage a part of dying myocardium and to improve the pump function of the left ventricle (12, 13). Efficacy and safety of intracoronary administration of two cytoprotective agents (Mexicor (2-ethyl-6-methyl-3-oxypyridine succinate) at a dose of 100–200 mg or Neoton (phosphocreatine) at a dose of 2 g) in patients during the acute period of myocardial infarction has been proved (11, 12, 13).

Optimally chosen drug therapy is important in treatment of cardiogenic shock. Werdan K. et al. (5) recommend to use dobutamine (2.5–10 μg/kg/minute) for inotropic support, noradrenaline (0.1–1 μg/kg/minute) as a vasopressor agent, and to add levosimendan (loading dose of 12–24 μg/kg for 10 minutes with further administration at a rate of 0.05–0.2 μg/kg/minute) in case of catecholamine-refractory cardiogenic shock. The authors do not recommend to use dopamine and phosphodiesterase inhibitors (Amrinone, Milrinone, Enoximone) for treatment of cardiogenic shock (5). We used inotropic dobutamine support in our female patient for the first seven days from the disease onset. During clinical death, in order to protect brain from ischemic and reperfusion injury, we consider it mandatory to use neuroprotection and deep pharmacologic sedation.

Intra-aortic balloon pumping is the most widely spread method of mechanical hemodynamic support in patients with cardiogenic shock (3). IABP makes it possible to increase diastolic perfusion of the coronary arteries and, at the same time, to reduce afterload on the left ventricle (2, 3, 5). The use of IABP in our patient during PCI and within the next three days made it possible to provide adequate blood flow in the coronary arteries and to gradually stabilize hemodynamics. It is commonly accepted that initiation of IABP prior to revascularization procedure can make the endovascular procedure itself more safe (3), and our case confirms this point of view. However, Sjauw K.D. et al. (4) did not reveal differences in mortality rate between the patients in whom IABP was initiated prior to revascularization and those in whom IABP was started immediately after.

Closed-chest cardiac massage is capable of ensuring sufficient blood supply of the brain and the heart in the settings of clinical death when IABP becomes useless. Correct conduction of closed-chest cardiac massage includes correct positioning of hands, deep compressions of the chest (4–5 cm) at a rate of about 100 per minute, full decompressions after each pressing and minimal duration of breaks (14). Efficacy of closed-chest cardiac massage is controlled rather by the amplitude of the pulse wave on photoplethysmogram and by the level of arterial blood oxygen saturation (SpO_2), which must be maintained above 90% with the

help of compressions, rather than by pulsation on the main arteries.

The use of mechanical lung ventilation (MLV) in AMI patients with cardiogenic shock improves blood oxygenation in the lungs, which makes it possible to increase oxygen delivery to the cardiac muscle and also relieves the body from the necessity to provide breathing, thus reducing the load on the heart (5). During sustained MLV, the following attenuated parameters of ventilation should be used: respiratory volume ⩽6 mL/kg and peak pressure in the airways ⩽30 mbar (5). Namely, the use of MLV ensured maintaining of optimal oxygenation level during the period of cardiogenic shock in our patient.

Therefore, this clinical case demonstrated that despite extremely unfavorable prognosis in acute myocardial infarction complicated by cardiogenic shock, clinical death and occlusion of three coronary arteries, an aggressive treatment tactics including early antegrade blood flow restoration in the IRA, intracoronary administration of cytoprotective agents and simultaneous complete endovascular revascularization accompanied by continuous resuscitation procedures (closed-chest cardiac massage, IABP and MLV) is the most effective one.

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Case of Ventricular Septal Defect Closure by an Occluder in a Female Patient with Mechanical Aortic Valve Prosthesis

Piskunov S.A., Kireeva T.S., Semenova M.R.*

Federal Center for Cardiovascular Surgery, Chelyabinsk, Russia

The authors present a case of ventricular septal defect closure by an occluder performed through the mechanical aortic valve prothesis.

Key words: *congenital heart diseases, ventricular septal defect, occluder, mechanical aortic valve prosthesis.*

Abbreviations

CHD – Congenital heart defect
IVS – Interventricular septum
VSD – ventricular septal defect

Female patient T. born in 1966 was diagnosed with a congenital heart defect (CHD) – aortic stenosis – at birth. She was followed up by cardiovascular surgeon, cardiologist, and no surgery was indicated. From August–September 2010, despite antibiotics treatment, she had persistent fever (38.5 °C). She was hospitalized for secondary bacterial endocarditis associated with CHD. She was diagnosed with aortic valve stenosis and insufficiency, subaortic stenosis. On March 10th, 2011 the patient underwent aortic valve replacement by mechanical prosthesis "MedInzh A25", along with excision of fibrous and muscular portion of interventricular septum, dilatation of the left ventricle outflow tract, partial excision of IVS with plasty by synthetic patch. Based on MRI data (July 02, 2012), basal segment of IVS was deformed (patch), VSD (4.5 × 5 mm) with high-velocity shunt was visualized at its lower third.

During diagnostic intervention (ventriculography), a catheter was accidentally passed through both cusps of aortic valve "MedInzh A25", with significant impairment of its function, i.e. the cusps could not be closed (Fig.1); hence, the blood pressure fell to 70/30 mm Hg. However, when the catheter was removed, the function of the prosthesis recovered. Nevertheless, based on ventriculography data (Fig. 2), it became clear that VSD of this size and location probably can be closed.

Considering relatively favorable location of VSD, the decision was made to attempt endovascular closure and to assess the possibility to perform it in the presence of implanted mechanical aortic valve prosthesis. We could not find any reports in the available literature on endovascular VSD closure in such a situation.

For a treatment stage, the diagnostic catheter LCB ("Merit Medical" Left Coronary Bypass), 5F was passed through the right (nearest to the defect) opened cusp of the prosthesis; in systole, both cusps rose perpendicularly to valve ring and the catheter produced no significant smashing effect (Fig. 3). While one cusp was working normally, there was no significant functional impairment of systolic and diastolic cycle throughout occluder implantation, although there were periodic car-

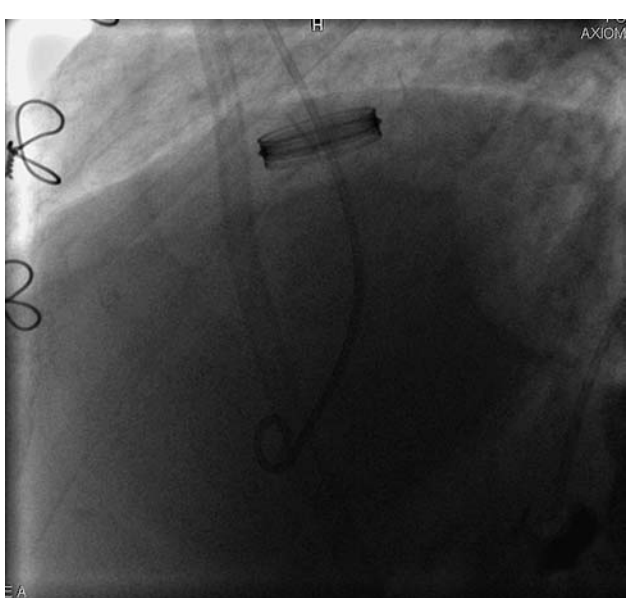

Figure 1. Diagnostic catheter is positioned between the valve's cusps.

* *Address for correspondence:*
Dr. Serguey Piskunov,
Head of the Department of Endovascular Diagnosis and Treatment
Federal Center for Cardiovascular Surgery
2, prospect Geroya Rossii Evguenia Rodionova,
Chelyabinsk, Russia, 454003
E-mail: piskunov.x-ray.s@mail.ru; offender83@mail.ru
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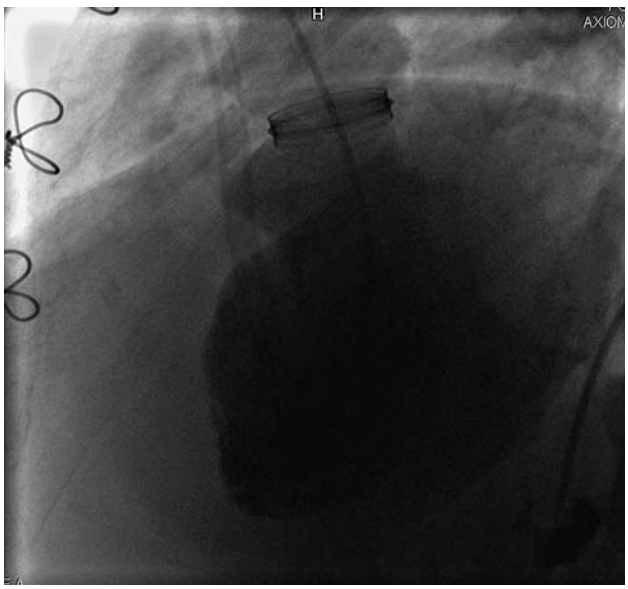

Figure 2. Left ventriculogram showing VSD.

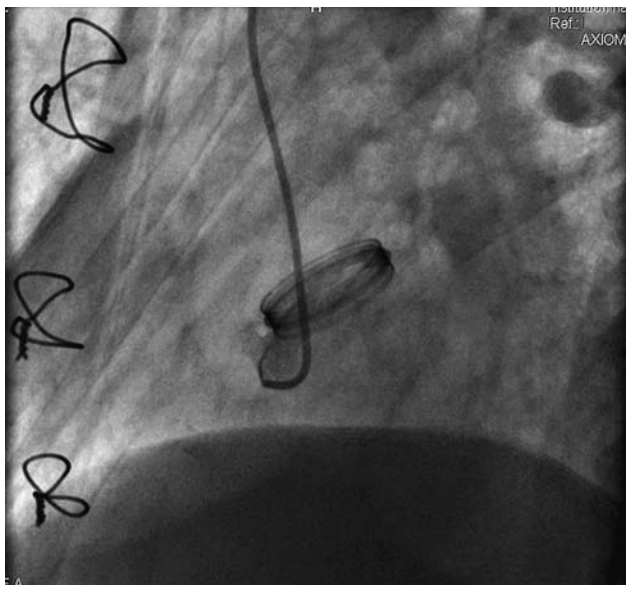

Figure 3. Optimal catheter position within the open right cusp.

diac rhythm disturbances managed with medications. The thinner catheter (<5F) did not provide appropriate support for guidewire passage through VSD to the right chambers. Hydrophilic guidewire Terumo Radiofocus Guide Wire M Angled Flex L 3cm 260 × 0.035" was placed in the left branch of the pulmonary artery relatively easily. According to the standard method, in order to minimize the probability of guidewire passage between tricuspid chords, the way from the right femoral vein to the left pulmonary vein was passed using Pigtail catheter. The loop-snare (ø25 mm) was introduced over the standard guidewire 260 × 0.035", a short tip of the hydrophilic guidewire was captured by this loop-snare (the tip was captured as the most flexible part of the guidewire in order to facilitate instrument bringing down and removal from the venous introducer sheath). The arterial catheter was replaced over the created arteriovenous loop for the following reason: as its supportive function was no longer needed, to minimize effects on prosthetic cusp, the catheter LBR3 ("Merit Medical" Left Coronary Brachial/Radial 3), 4 Fr was placed. The possibility to ensure the continuous contact between catheter tip and delivery shaft 6F significantly facilitates overcoming a number of anatomical obstacles and VSD. To create such a stable contact, two torque devices for 0.038" guidewire were tightened over the wire at the proximal edges of the catheter and delivery shaft joined together. This monolithic construction allowed the surgeon, while passing the delivery shaft without assistance, to achieve its tension or whipping at the side of interest, not thinking on possible loosing of one of the guidewire tips.

When a perimembranous VSD is closed under the natural valve, the delivery shaft is preferably moved to the aorta. In this case, the necessity of minimal impact on the prosthesis required the delivery system to be moved to the left ventricle. It was not difficult, because a quite flexible catheter 4F combined with the hydrophilic guidewire "Terumo" of similar flexibility allowed the delivery system to be securely moved forward to the left ventricle, with minimum effects on aortic prosthesis (Fig. 4).

The measured VSD diameter was 4.5 mm. To close this defect, perimembranous occluder

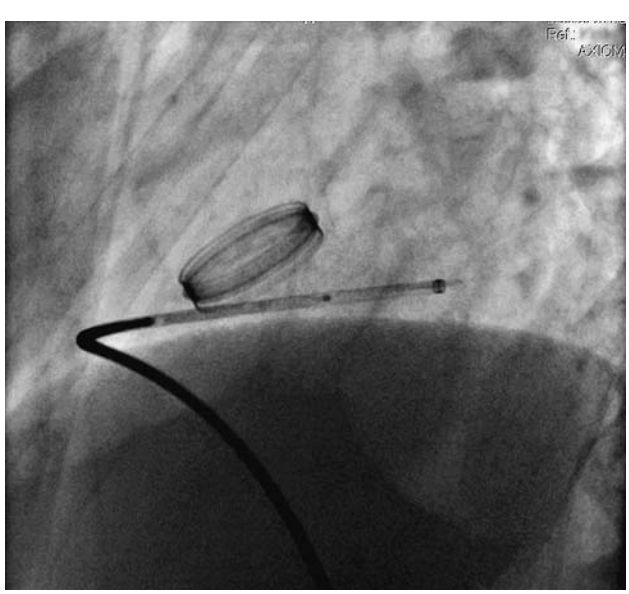

Figure 4. Occluder's delivery system in the left ventricle.

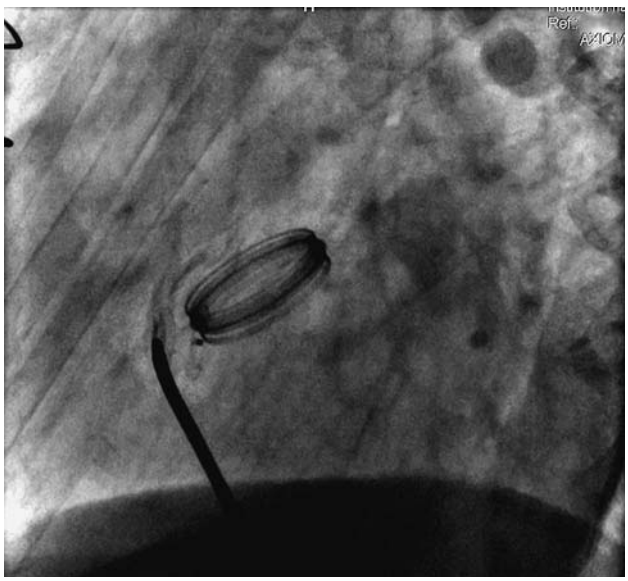

Figure 5. Right disc of the occluder in the right ventricle.

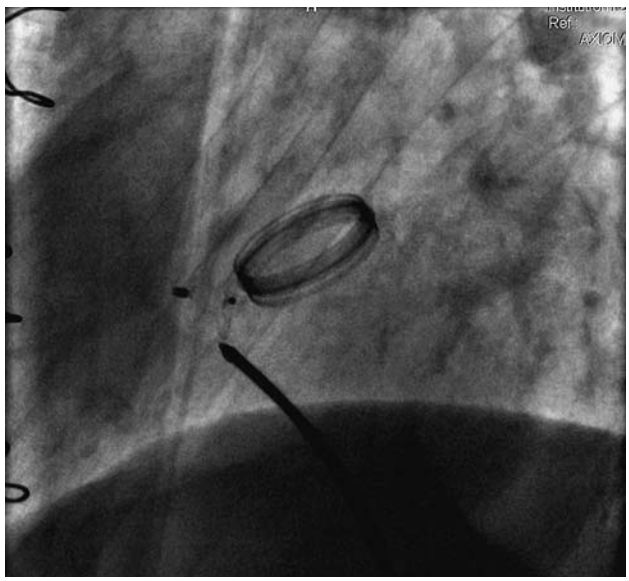

Figure 6. Final position of the occluder.

VSD XJFVM07AII (Lifetech Scientific) was chosen (symmetrical, with larger left disk 14.6 mm and smaller right disk 12 mm, isthmus diameter 7 mm and isthmus height 3 mm). Its left ventricular disk was rotated near the inflow tract of the LV and pulled up to the defect edge. The right disk was opened when the delivery system was moderately tensed. After occluder removal from the delivery system, contrast media could be administered through the delivery system. Contrast-enhanced examination though the delivery system confirmed that the right disk was located in the RV (Fig. 5). Additionally, contrast agent administered from the LV in the occluder area proved its optimal implantation with sufficient distance from aortic valve prosthesis and moderate permeation of contrast agent through nonwoven haemostatic material of the occluder (Fig. 6). The delivery system was safely separated from the occluder by unscrewing. On the next day after implantation, transthoracic Echo-CG revealed that: “minimal shunt through the occluder disks could not be excluded”, that is quite acceptable in the immediate post-intervention period given continuous Warfarin intake by the patient.

This case demonstrated that careful manipulations related to occluder implantation for VSD through the mechanical aortic valve prosthesis are possible and safe.

Hybrid Surgical intervention in a Patient with Thrombosed Abdominal Aortic Aneurysm

Akchurin R.S., Imaev T.E., Lepilin P.M., Kolegaev A.S., Pokidkin I.A., Margolina A.A., Komlev A.E.*

Russian Cardiology Research and Production Complex
Department of Cardiovascular Surgery, A.L. Myasnikov Research Institute of Clinical Cardiology, Moscow, Russia

Encouraging short- and mid-term results have made the endovascular abdominal aortic repair (EVAR) in combination with implantation technique of the chimney stents a method of choice in treatment of complex abdominal aneurysms in our clinic. Our personal observation is one of a few cases described in literature, involving the use of the chimney technique with unilateral endovascular repair of thrombosed abdominal aortic aneurysm (AAA) and simultaneous femorofemoral bypass.

Key words: *thrombosed abdominal aortic aneurysm, endovascular abdominal aortic repair, AAA, EVAR, chimney stents, chimney technique, stenting of the renal arteries, hybrid surgery.*

Introduction

Endovascular abdominal aortic repair (EVAR) is a minimally invasive intervention which, considering the modern level of this method development, currently becomes a method of choice in treatment of patients with aneurysmatic lesion of abdominal aorta. However, in case of thoracoabdominal, juxta- and pararenal aneurysms, the possibilities of endovascular method are limited due to inability to comply with anatomic criteria, predetermining the direct success of the intervention or a favorable long-term prognosis. Appearance of branched and fenestrated endografts made it possible to perform endovascular procedures in patients with anatomy of the aneurysm unacceptable for traditional EVAR (in particular, without satisfactory proximal or distal fixation zone). Unfortunately, these endografts are very expensive and, besides, they require individual manufacturing which makes them almost inapplicable in emergency situations. It also should be noted that there are specific anatomic contraindications for the use of fenestrated/ branched endograft, e.g. significant tortuosity of iliac arteries.

A few years ago T. Larzon (1), M. Lachat et al. (6) suggested adding renal artery stents to EVAR in cases of abdominal aortic aneurysms (AAA) of juxtarenal localization, locating proximal departments of stents along aortic axis, parallel to the main body of the endograft in the cranial direction, which made it possible to preserve renal blood flow when implanting aortic endograft above the orifices of the renal arteries. Later, special "coated" stents-endografts came into use besides conventional stents. This operative technique was called a chimney technique. It is successfully used in patients with juxtarenal and suprarenal aortic aneurysms (LINC: Larzon 2008, Ohrlander 2008, Hiramoto 2009, Donas & Torsello 2010, Kolvenbach 2010, Lobato 2010, Bruen 2011, Coscas 2011 et al.), in aneurysms with complex morphology of the neck, and in emergency cases to expand the proximal fixation zone. Later on, the chimney technique began to be used also in thoracic endovascular aortic repair (TEVAR) to preserve the blood flow in branches of aortic arch in case of necessity to cover their orifices (2–4).

The first results of TEVAR and EVAR use in combination with the chimney technique were published in 2008 (5). To date, dozens of observations have been published, data from multicenter studies with short- and mid-term results of chimney stent implantation during elective and urgent endovascular interventions for AAA, thoracoabdominal aneurysms and aortic ruptures have been presented (6–10).

Case presentation

Our own observation is one of a few cases described in literature, involving the use of the chimney technique with unilateral endovascular repair of thrombosed AAA in combination with simultaneous femorofemoral bypass (11).

* *Address for correspondence:*
Dr. Ilya Pokidkin
Russian Cardiology Research and Production Complex, Research Institute of Clinical Cardiology, Department of Cardiovascular Surgery
3rd Cherepkovskaya street, 15a, Moscow, 121552,
Russian Federation
Тел. +7-495-414-66-21, +7-926-265-37-57
E-mail: : pokidkin@me.com
Manuscript received on October 3, 2013
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A 69-year-old patient A., male, was admitted to the Department of Cardiovascular Surgery of "Russian Cardiology Research and Production Complex", complaining of periodical dull pain in the mesogastrium, acute burning pain in the right lower limb when walking on a distance of over 150 m. Medical history: coronary artery bypass surgery (2000), stenting of the right coronary artery (2006), paroxysmal atrial fibrillation.

Examination findings

Ultrasound duplex scanning of the lower limb arteries detected: collateral blood flow in the right common femoral artery (CFA) (occlusion of the right aortoiliac segment); up to 60% extended stenosis of the right CFA due to heterogenic calcinated atherosclerotic plaques involving the orifice of the deep femoral artery (DFA); diffuse atherosclerotic changes of both superficial femoral arteries (SFA); up to 45% extended stenosis of the right and left popliteal arteries; hemodynamically significant stenosis of the left posterior tibial artery in the proximal third and of the left superficial tibial artery in the distal third of the shin; collateral blood flow in the arteries of the right lower limb; ankle brachial pressure index: 0.36 on the right, 0.57 on the left.

Multislice spiral CT-aortography (Figure 1 A, B) revealed infrarenal aneurysm of abdominal aorta originating directly from the orifice of the right renal artery up to the bifurcation level with parietal thrombosis, thrombotic occlusion of the right common iliac artery (CIA).

According to medical history data and the results of investigation, the following diagnosis was established: Multifocal atherosclerosis. Thrombosed infrarenal aortic aneurysm. Thrombotic occlusion of the right CIA. Stenotic atherosclerosis of the lower limb arteries. Coronary heart disease (CHD): atherosclerosis of aorta and coronary arteries. Condition after the coronary artery bypass surgery (2000), stenting of the right coronary artery (2006). Rhythm and cardiac conduction disturbances: paroxysmal atrial fibrillation; right bundle branch block and left anterior fascicular block. Chronic obstructive pulmonary disease, mild course.

The patient underwent the hybrid surgery: unilateral endoscopic repair of abdominal aorta using the chimney technique (infrarenal aortic aneurysm without sufficient proximal neck) (Figure 2 A,B) and femorofemoral bypass (thrombotic occlusion of the right CIA and circulatory decompensation in the right lower limb).

Surgical intervention

Left-sided subclavian approach was performed under endotracheal anesthesia. CFA was approached bilaterally. The arteries were fixed by traction sutures. The arteries were sutured with purse-string prolene 5-0 stitches. 5Fr sheaths were placed. Diagnostic catheter Pigtail on a rigid guidewire was inserted through the right CFA. Diagnostic aortography, catheterization of the renal arteries and superior mesenteric artery were performed using a rigid 0.035 guidewire, JR catheter. Two coated self-expanding stents (Gore Viabahn 10 × 5 mm and 9 × 5 mm) were inserted through the sheaths in the left subclavian artery via rigid guidewires and positioned in the renal arteries. The sheath in the left CFA was changed to Gore Dryseal 24 Fr sheath. Delivery system was inserted through the sheath in the left CFA, and unilateral endograft (aortic extension piece) Medtronic Endurant (28 × 28 × 49 mm) was positioned in the abdominal aorta. Initial stage of endograft deployment was performed: the endograft crown was opened and suprarenal fixation of the endograft was achieved. Medtronic Reliant balloon was positioned in the proximal segment of the endograft. Gore Viabahn endografts were deployed and Medtronic Reliant balloon was dilated simultaneously. Aortography detected: patent renal arteries, and no signs of endoleak. Additional deployment of

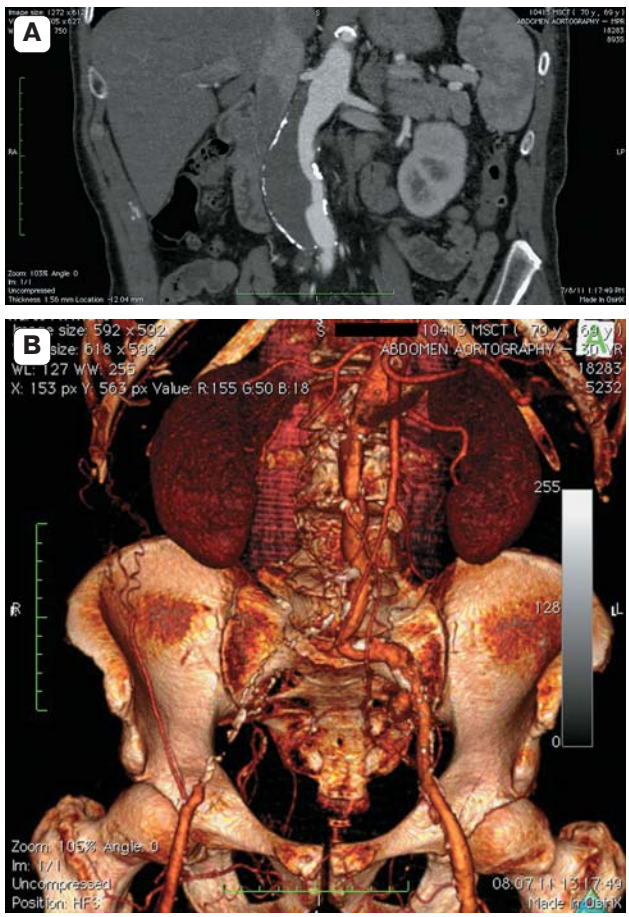

Figure 1 A, B. Multiplanar and 3D reconstruction of multispiral CT of a patient prior to the hybrid surgical intervention.

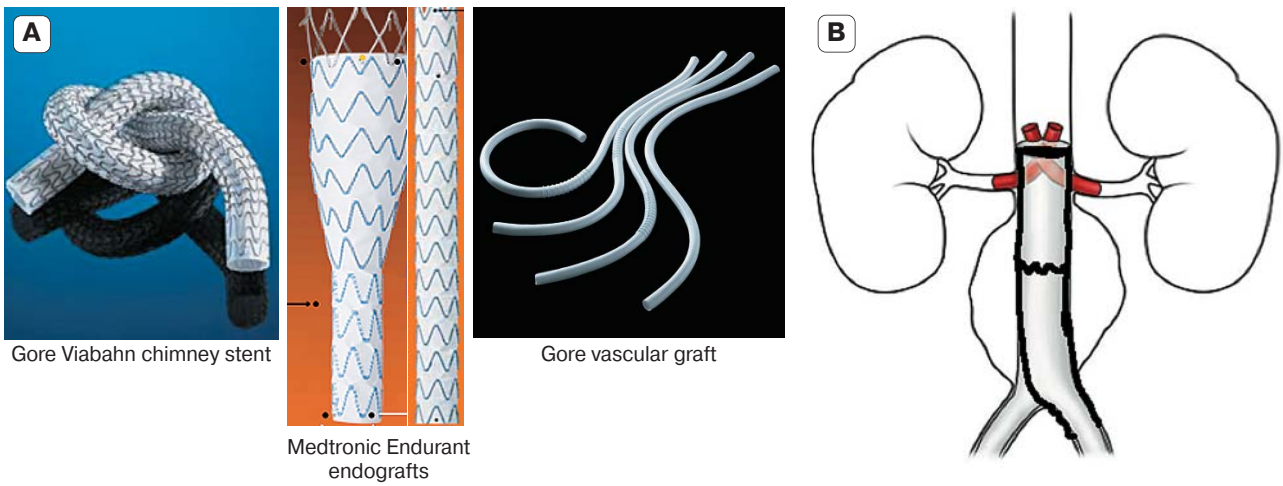

Figure 2 . A – Vascular stents, endografts and grafts used during the hybrid surgical intervention; B – Schematic figure of the endovascular stage of the hybrid surgery: unilateral endografting and the chimney technique.

Medtronic Endurant endograft was performed. Delivery system was removed, additional lengthening endograft (iliac "crus") Medtronic Endurant (28 × 28 × 82 mm) was inserted and deployed via a rigid guidewire. Medtronic Endurant endograft, junctions with lengthening endograft and the lengthening endograft itself were ballooned via Medtronic Reliant balloon. Final angiography revealed the following: patent renal arteries, adequate positioning of endografts, no endoleaks. Catheters, guidewires, sheaths were removed (tourniquets of purse-string sutures were tied).

Arteriotomy of both left and right CFA was performed. Clamps were placed on the CFA, SFA, DFA; tourniquets were applied on the branches. Femorofemoral bypass was performed using vascular Gore-Tex graft and Gore-Tex 5-0 thread. Reperfusion was restored. Anastomoses on revision were non-leaking. Hemostasis was achieved. The wounds were closed in layers. Drainages were active. Aseptic dressings were applied.

Postoperative clinical course was unremarkable; wounds healed by primary intention; no infectious complications were observed.

On Day 4 after the surgery control multispiral CT-aortography was performed (Figure 3 A, B): aneurysm cavity was excluded from the systemic blood flow, renal arteries were filled with contrast media with no signs of stenosis, chimney stents in the renal arteries were patent, no endoleak was revealed. Bypass from the left to the right CFA was patent along the whole length.

Discussion

Reported clinical case demonstrates one of the fields of using the chimney technique – endovascular treatment of AAA with almost absent proximal neck and parietal thrombosis of the side visceral branches. In this case the use of chimney stents in the proximal part of the endograft made it possible to optimize the proximal fixation zone. This technique may also be used to dilate the distal endograft fixation zone, e.g. in descending aortic aneurysms when other variations of the chimney technique are used such as multilevel "terraced" technique in case of 3- or 4-vessel stenting, descending "periscope" stents and some others. Peculiarity of this technique consists in the necessity of additional "superior" vascular approach (in particular, left subclavian approach which we used in our case).

Preoperative planning includes choosing the site of approach, assessing the state of aneurysm neck (length, diameter, condition) and endograft fixation zone, analyzing the variant anatomy of aortic branches (caliber, angulation, calcification). Key moments of using the chimney technique are as follows: competent planning of the intervention, simultaneous deployment of the endograft and chimney stents, adequate oversizing to prevent endoleaks on the sides of the stents (grooves), the use of compatible combinations of endografts and stents.

"Achilles' heel" of the chimney technique is the development of type 1 endoleak which can potentially cause aneurysm rupture after the EVAR. Relatively high incidence of this complication is connected to inevitable formation of side slit-like channels between the stent graft, chimney stents and native aortic wall. There were no endoleaks, including type 1 endoleaks, in our observation. According to literature data, in the long-term period after the EVAR with chimney technique, the incidence of

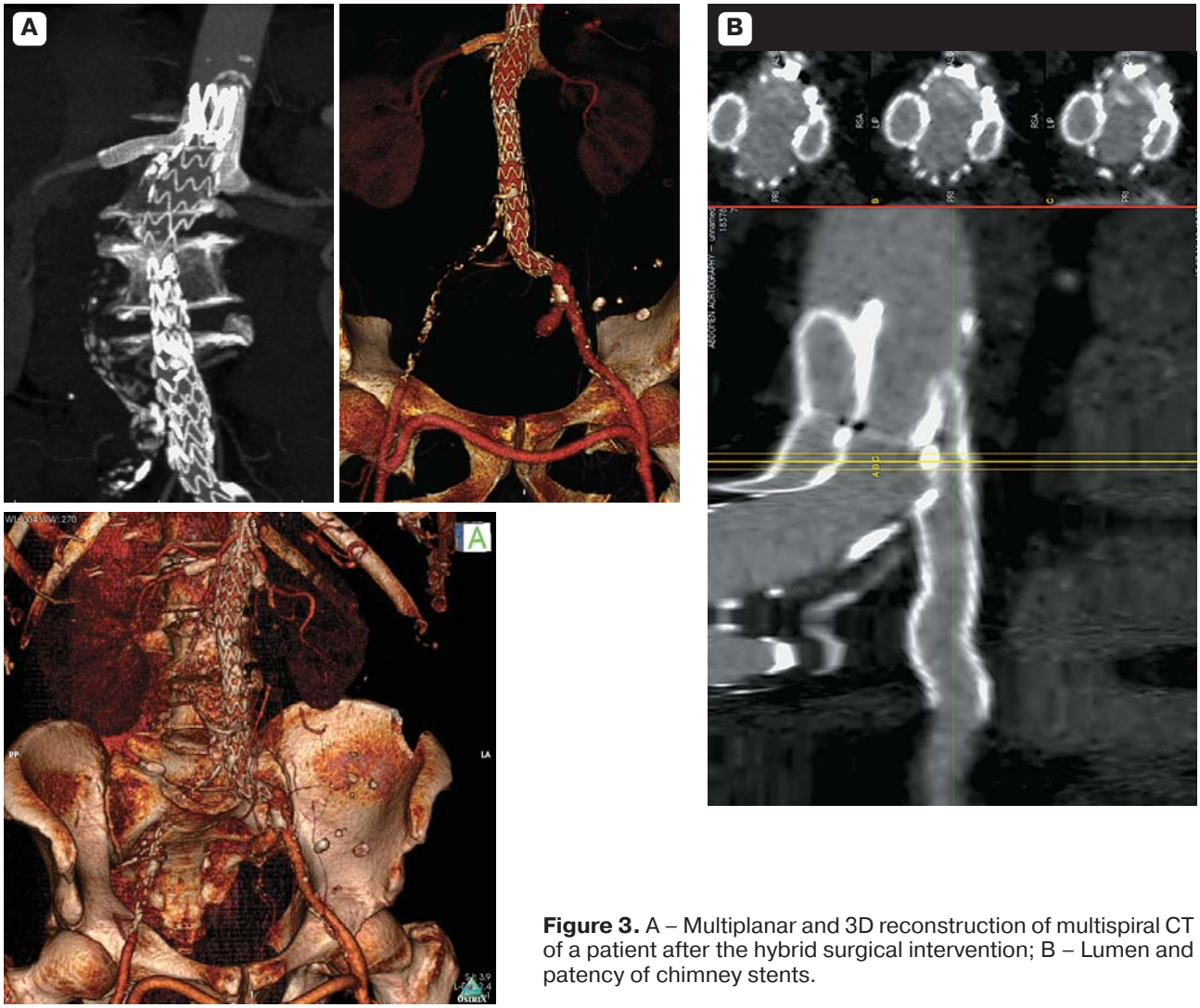

Figure 3. A – Multiplanar and 3D reconstruction of multispiral CT of a patient after the hybrid surgical intervention; B – Lumen and patency of chimney stents.

type 1a endoleaks did not exceed 10% in the majority of observations; moreover, most of them spontaneously disappeared in 6 months (8). Nevertheless, the true incidence of endoleaks can be slightly higher considering a relatively small number of enrolled patients (5, 12, 13 etc.).

In order to decrease the risk of type 1 endoleak, some experts (M. Malina, G. Torsello et al.) suggest to use long chimney stents which create longer side channels and, therefore, are associated with a higher incidence of spontaneous thrombosis, as resistance to blood flow is proportional to the length of grooves. For the same purpose, they suggest to position and deploy chimney stents spirally (wrapping around the main endograft body) (M. Malina, LINC 2010).

Other unsolved issues include: maximal number of eventual chimney stents, their size and oversizing; advantages of using coated or uncoated, self-expanding or balloon-expandable stents; optimal design of the endograft and properties of stent material. Coated stents (endografts) are used more often due to a lower possibility of endoleak; moreover, in case of renal and mesenteric arteries originating from the aneurysm cavity, their use is obligatory. Besides, the use of coated stents facilitates their repeated catheterization, if necessary, for example, in inadequate renal blood flow after the implantation. The use of balloon-expandable (e.g., Atrium Advanta) and self-expanding stents (Gore Viabahn) demonstrated comparable results, including those on the risk of endoleak occurrence (5, 10, 14, 15).

As opposed to branched endografts in abdominal aortic aneurysms when the branches of the graft are not fixed in the aneurysm cavity affected by the cardiac cycle and respiratory movements, the chimney technique allows us to achieve stable position of coaxial stents which may positively affect the incidence of long-term type 2 endoleaks.

In our opinion, further technique improvement will be, first of all, related to the search of the ideal chimney stent model. It is obvious that biomechanical characteristics of this particular component determine the possibilities of improving immediate and long-term result of the surgical intervention under consideration. Ideal chimney stent should be low-profiled, coated and it should combine plastic properties of a balloon-expandable stent in the proximal part with sufficient radial force of a self-expanding stent in its distal part. Available lengths (30–200 mm) and diameters (5–10 mm) of the stents do not cover current surgical needs, and their line should be expanded. Density of the stent material in the proximal aneurysm neck should be sufficient for clear visualization and maximally accurate positioning. The presence of special markers on stents used as chimneys, which would improve their visualization, would be convenient. Perhaps, it is reasonable to develop specific design for the proximal part of the stent in the shape of the faucet for more convenient ballooning and in order to facilitate its catheterization in case of repeated interventions. The issues of steerage and flexibility of the stent delivery system are also topical from the point of view of their further improvement. Finally, it is necessary to develop flexible guidewires with variable rigidity to provide safe access and fixation in the aortic branches.

Limitations for using the chimney technique are as follows: abdominal aortic aneurysms without an adequate neck (the risk of endoleak); type I-III thoracoabdominal aneurysms with long neck, prolonged dissections involving visceral arteries in order to use chimney stents of corresponding length to reach the proximal neck. Sandwich technique can be applied in the abovementioned cases (A.C. Lobato, LINC 2010).

It should be emphasized that the use of the chimney technique is justified at the sites with a great experience of endovascular and hybrid interventions. The use of technique by inexperienced or minimaly experienced operators causes difficulties in positioning endografts, type 1 endoleaks; and accumulation of experience should take place under the guidance of experienced operators/proctors (17).

Conclusions

The chimney technique is used to prevent ischemia of the side aortic branches in case of absent or insufficient fixation zone both during emergency and elective endovascular interventions. Until anatomic indications for fenestrated endografts are expanded and until already manufactured fenestrated/branched endografts are available at affordable price, chimney stents will remain an acceptable and, specifically, cheaper alternative for the patients at high surgical risk (18). There is an opinion that from the safety point of view the chimney technique has an advantage over traditional open surgical interventions and is competitive with the latter in efficacy (16).

Encouraging short- and mid-term results have made the EVAR in combination with implantation technique of the chimney stents a method of choice for the treatment of complex abdominal aneurysms in our clinic; however, further studies and analysis of long-term results are required to spread and recommend this technique (19).

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Hybrid Surgical Intervention in a Patient with Multistage Atherosclerotic Lesions of Peripheral Vessels: Carotid Endarterectomy with Single-Stage Retrograde Transcarotid Stenting of Brachicephalic Trunk, Femoral-Femoral Bypass and Stenting of Left External Iliac artery. Clinical Case

Akchurin R.S., Imaev T.E., Pokidkin I.A., Osmanov M.R., Lepilin P.M., Kolegaev A.S., Medvedeva I.S., Komlev A.E.*

Russian Cardiology Research and Production Complex
Department of Cardiovascular Surgery, A.L. Myasnikov Research Institute of Clinical Cardiology, Moscow, Russia

We present a clinical case of simultaneous endovascular approach and traditional surgical revascularization in an elderly patient with multifocal atherosclerotic lesions have made the intervention less traumatic without its separation into several stages and helped to radically correct blood supply in various arterial territories.
Key words: *Hybrid surgical intervention, multistage atherosclerotic lesions of peripheral vessels, carotid endarterectomy with single-stage retrograde transcarotid stenting of brachiocephalic trunk, femoral-femoral bypass, stenting of left external iliac artery.*

Introduction

Multifocal lesions of aortic arch branches and major arteries pose a rather difficult problem for surgeons – to choose a treatment strategy that would be as aggressive as possible in struggle against the disease and, in the same time, conservative with regard to patient, in order not to make surgery consequences worse than the disease itself. Our clinical observation can be considered one of illustrations of his statement.

Aneurysms of brachiocephalic trunk (BCT) are a rare disease and occur in 1–5% of patients with indications for carotid territory revascularization (13, 14, 21, 33). Such aneurysms are associated with a serious risk of embolism and thrombosis, logically leading to cerebrovascular accident (CVA) and also to the syndrome of surrounding tissues local compression (1–3, 8). Aneurysms of the mentioned localization commonly are of degenerative, traumatic (including iatrogenic) nature and are less often caused by genetic and infectious factors (8). According to observations made on relatively small groups of patients, the vessel is damaged in its proximal part or along its entire length in most BCT aneurysms (1–3), and isolated BCT involvement into aneurysm process is very rare (8).

BCT aneurysm is most frequently asymptomatic (up to 50% of cases), becoming an accidental finding during diagnostic examinations. Symptomatic aneurysms, as a rule, are revealed due to their association with embolism episodes which are more often observed in minor BCT aneurysms (8). Neurological disorders and compression syndrome are described in a half of cases, and total mortality in untreated aneurysms, according to various authors, achieves 70% (3, 9, 10).

Reconstruction surgeries for BCT aneurysms are performed using different surgical approaches including median sternotomy, cervical, transthoracal approaches (1–5), as well as different modifications (for example, partial superior sternotomy or right superior thoracotomy) (4, 6, 7). Unfortunately, none of methods mentioned above can be considered as optimal for BCT intervention due to insufficient visualization and quite high frequency of complications at the site of approach, especially in elderly patients who form a significant part among patients with pathology under consideration

* *Address for correspondence:*
Dr. Ilya Pokidkin
Russian Cardiology Research and Production Complex, Research Institute of Clinical Cardiology, Department of Cardiovascular Surgery
3rd Cherepkovskaya street, 15a, Moscow, 121552,
Russian Federation
Тел. +7-495-414-66-21, +7-926-265-37-57
E-mail: : pokidkin@me.com
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(1, 4, 12). Neurological disorders (cerebrovascular accident, transitory ischemic attack, paralysis of recurrent laryngeal nerve) are the most frequent complications in combined surgeries on carotid territory and aortic arch branches. Causes of postoperative neurological deficit may be embolism, thrombosis or consequences of global hypoperfusion after operations with extracorporeal circulation and aorta and major vessels cross-clamping.

Endovascular interventions have made a revolution in treatment of peripheral major vessels and are currently becoming a surgery of choice in many surgical centers (18, 22, 23). Focal occlusions/stenosis of aortic arch branches can be effectively and safely eliminated by balloon angioplasty and stenting, including patients of high surgical risk (8). On the other hand, endovascular method is not optimal for treatment of proximal BCT aneurysms due to technical difficulties during vessel catheterization, especially in case of significant atheromatosis or unfavorable anatomy of aorta arch; thus, a risk of perioperative cerebrovascular accident increases (16, 24, 25). Concerning interventions for carotid arteries stenosis, carotid endarterectomy, as known from multiple randomized multi-center studies, is accompanied by substantially lower percentage of perioperative ischemic events compared to stenting, especially in case of bifurcation lesions (19, 20).

To solve the problem of optimal correction of combined atherosclerotic lesions of BCT and distal parts of brachiocephal arteries, a hybrid surgical approach is used, i.e. carotid endarterectomy and BCT stenting; hence, the operations in general have become significantly less traumatic without losing apparent advantages of cavitary intervention (11, 26, 36).

According to meta-analysis of more than 13 studies which include in total 133 patients, combined BCT and carotid lesions were revealed predominantly in men, with frequent ipsilateral lesions of carotid arteries and BCT; almost all patients had clinical symptoms. More than a half of patients underwent BCT stenting, the rest underwent balloon angioplasty. In the majority of analyzed papers, neurological disorders were not reported and only in one paper 2 cerebrovascular accidents due to BCT occlusion (after technically difficult carotid endarterectomy and possible parietal stent thrombosis) were described (13–18, 27–31). In this study, the necessity of adequate heparinization of patient and carefully flushing of common carotid artery though arteriotomy approach prior to final removal of clips from BCT was specifically highlighted (14). According to the results of this meta-analysis, 30-day mortality among operated patients did not exceed 1%, stroke frequency did not exceed 2% and 3-year mortality was about 13%. Restenoses were observed in 7% of patients, in all cases repeated angioplasty or bypass surgery was performed.

To date, there are scarce reports concerning long-term results of hybrid surgery for multistage atherosclerotic lesions of major vessels (13–18), although concomitant lesions of lower extremities arteries are not rare in patients with cerebral atherosclerosis and often require independent surgical treatment (32).

Clinical case

We present a clinical case of successful hybrid surgical intervention in a patient with multi-stage atherosclerotic lesions of peripheral vessels: carotid endarterectomy with single-stage retrograde stenting of brachicephalic trunk (BCT), femoral-femoral bypass (FFB) and stenting of left external iliac artery (EIA).

Patient L., 77 years old, male, surgeon by profession, was admitted to the department of cardiovascular surgery of Russian Cardiology Research-and-Production Complex with complaints of intermittent claudication and distance of painless walk about 150 m, non-system dizziness, memory decline for current events, hand tremor. Medical history: smoking for more than 50 years, arterial hypertension, cerebrovascular accident in left mesencephalic territory (2009).

On examination: difference between systolic arterial pressure on upper extremities 30 mm Hg. (D<S), pulse of low strength on major arteries of low extremities, murmur in projection of right carotid artery, fine tremor at rest.

Ultrasound duplex scanning of brachiochephalic arteries: BCT dilation up to 16 mm, 40% stenosis in bifurcation of right common carotid artery (CCA) due to heterogeneous atherosclerotic plaque with calcinosis extending onto orifice and proximal third of internal carotid artery where stenosis up to 70% was revealed. Distal bed was patent.

Duplex scanning of low extremities arteries: occlusion of right common femoral artery (CFA), prolonged stenosis of the right superficial femoral artery (SFA) and left CFA up to 45%. Blood flow in arteries throughout the right low extremity was of collateral type. Malleolar pressure index on the right anterior tibial artery (ATA) was 0.62, on posterior tibial artery (PTA) – 0.15.

EchoCG: thickening of aorta, heart cameras were not increased, contractility of left ventricle was satisfactory, there were no hypokinesia areas; hemodinamically insignificant valve regurgitations.

Multispiral CT-aortography (Fig. 1): occlusion of right IIA and CFA, right PTA, stenosis of left EIA was 80%. BCT aneurysm, stenosis of right ICA was 70%.

Brain MRI: local cerebrovascular lesion. Cyst of right brain hemisphere.

Blood tests: increased level of creatinine up to 131 mcmol/l, GFR by MDRD - 49 ml/min/1.73m2

Considering absence of coronary history, normal EchoCG data.

Based on clinical instrumental data, the following diagnosis was made: Multifocal atherosclerosis. Obliterating atherosclerosis of low extremities arteries. Occlusion of right EIA, CFA, right PTA, stenosis of left EIA up to 80%, stenosis of left ATA. Chronic arterial insufficiency of low extremities 2B stage by Pokrovsky-Fontain. Chronic brain ischemia. Atherosclerosis of brachiocephalic arteries. Occlusion of left ICA. Aneurysm of brachiocephalic trunk. Stenosis of right ICA up to 70%. Condition after cerebrovascular accident in left mesencephalic artery (2009). Stage 2 discirculatory encephalopathy. Vascular parkinsonism.

Essential arterial hypertension of stage 3 with kidney damage. Chronic kidney disease of stage 3. Chronic obstructive pulmonary disease, moderate course. Lung emphysema, pneumosclerosis. Pigeon chest. Disorder of carbohydrate metabolism Severe myopia.

Surgical intervention

Approach to the right CCA, ICA and external carotid artery (ECA) was performed under combined endotracheal anesthesia. Approach to the left and right CFA and their branches was performed simultaneously. System heparinization. Cross-clamping of carotid arteries. Endarterectomy of the right CCA bifurcation with extension to ICA was performed using Pruitt-Inhara internal bypass. Atherosclerotic plaque disappeared. Defect was repaired by polytetrafluoroethylene Gore-Tex patch. Clips were removed from arteries with prevention of air embolism. Anastomosis was patent, hermetic. Duration of cross-clamping was 5 minutes. System heparinization. Clips were put on CFA, SFA and deep femoral artery (DFA). Thromboendarterectomia from the right CFA, endarterectomy from the left CFA. Femoral-femoral bypass by Gore-Tex vascular prosthesis was realized. Introducer was put into the left CFA, soft guide wire and then rigid guide wire were introduced in succession. Diagnostic catheter was inserted into abdominal aorta via guide wire. Diagnostic aortography was conducted: extended

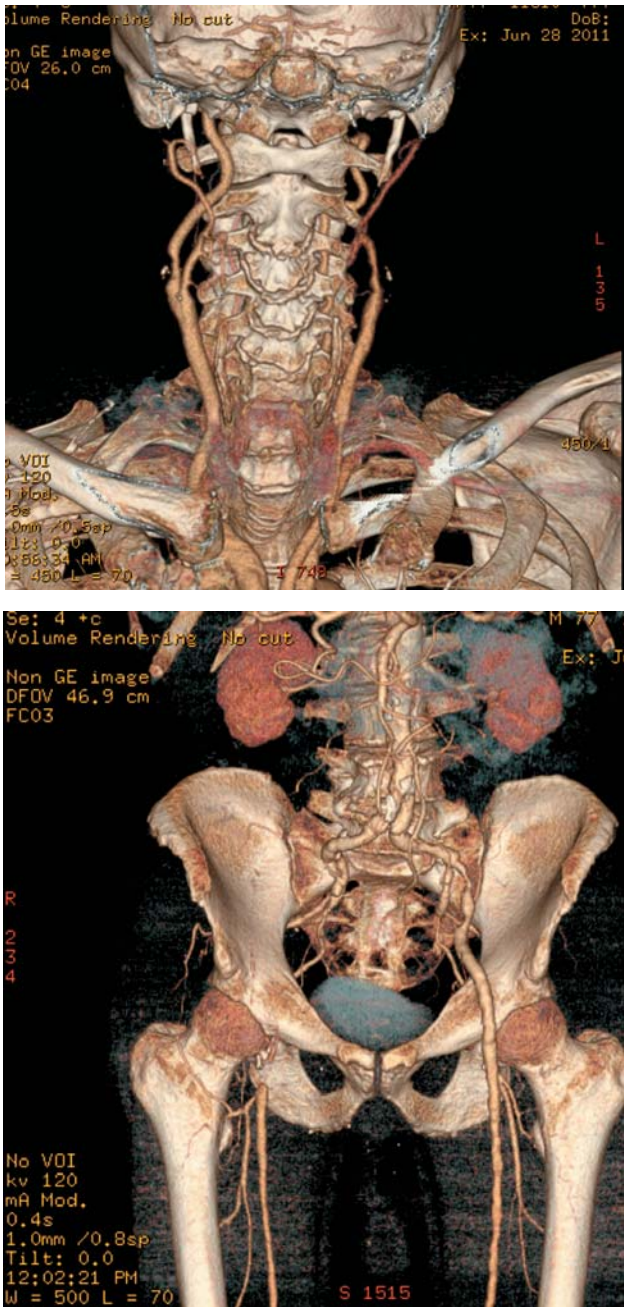

Figure1. MSCT of the patient prior to surgery (3D-reconstruction).

stenosis of the left EIA was diagnosed. Via rigid guide wire, Cook introducer was inserted to carry a stent delivery system Cook Zilver Flex 10 × 80 mm. Stent was positioned and opened.

Diagnostic arteriography. Ballooning of stent body was performed by Invatec Admiral Extreme 6 × 30 mm and 10 × 40 mm balloons. Diagnostic catheter was inserted into the ascendant abdominal aorta over guide wire, diagnostic aortography was performed. BCT aneurysm sizes were determined. Introducer was inserted into the right CCA, and endoprosthesis Gore Viabahn 13 × 50 mm was put through it using a rigid guide wire. Cross-clamping of right ICA. Endoprosthesis was positioned and opened.

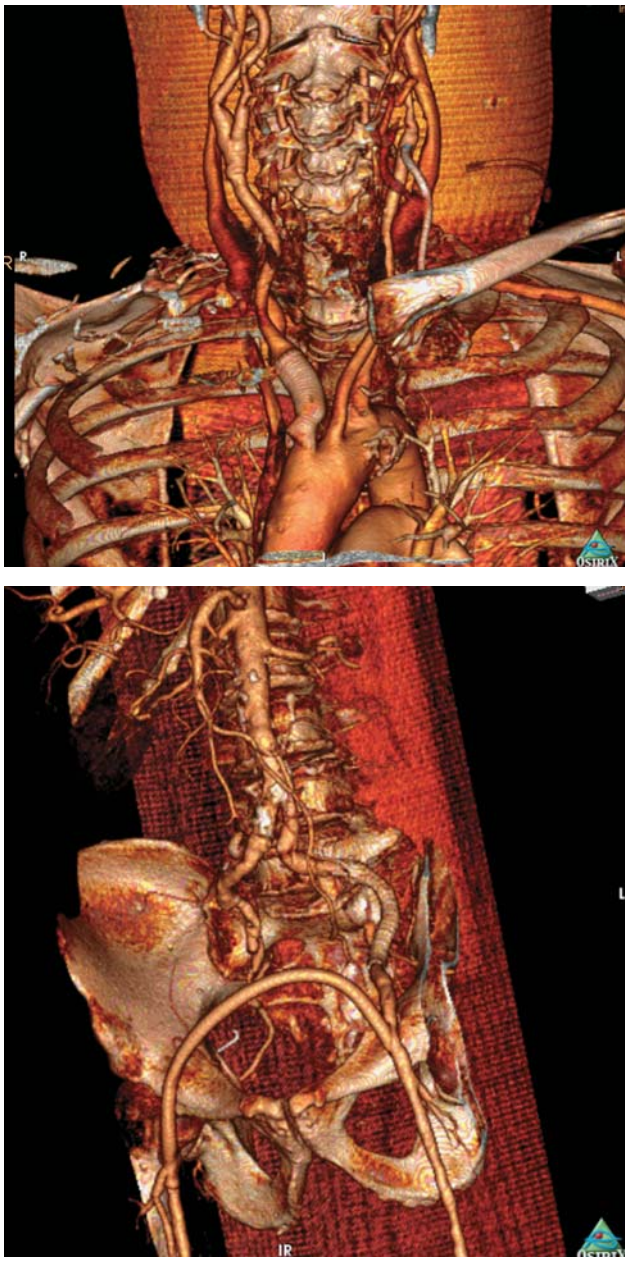

Figure 2. MSCT of the patient after hybrid surgical intervention (3D reconstruction).

Diagnostic aortography. Ballooning of endoprosthesis body was performed by Invatec Admiral Extreme 6 × 30mm and 10 × 40 mm balloons.

Intraoperational complications were not reported. The postoperative course was uneventful.

Long-term follow-up was 12 months; according to ultrasound examination and MSCT data (Fig. 2) no signs of stenosis exacerbation in both ICAs or BCT restenosis were revealed. There were no cerebrovascular accidents during the follow-up. In catamnesis, the patient resumed his labor activities (administrative work) and reported improved cognitive and mnestic brain functions.

Tactics of carotid endarterectomy and BCT stenting was chosen due to hemodinamically significant diffuse stenosis of right CCA bifurcation and ICA according to National guidelines for the management of patients with peripheral arterial disease (37). Presence of surgical approach to the right CCA and possibility of ICA cross-clamping allowed retrograde procedures to be performed at the next intervention stage using guide wires and catheters with significantly less risk of embolism complications. According to Karathanos C. et al. (35) study data, ICA cross-clamping prior to BCT stenting is an important measure to prevent cerebral embolism.

Conclusion

Due to potential cerebral complications, BCT aneurysms should be treated surgically at early stages using minimally invasive methods. Meta-analysis results confirmed that combined stroke incidence and mortality for BCT stenting is comparable or less than that for isolated endarterectomy (35). According to literature data, this tactics is characterized by good mid-term results including decreased risk of neurological complications and relatively reduced postoperative rehabilitation period; this favorably impacts hospitalization costs (35). In the clinical case we described, simultaneous endovascular approach and traditional surgical revascularization in the elderly patient with multifocal atherosclerotic lesions made intervention less traumatic without its separation into several stages, with radical correction of blood supply in different arterial territories.

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Experience with the Use of Angiox (Bivalirudin) in Acute Coronary Syndrome (ACS) Patients with Complications Caused by Percutaneous Coronary Intervention (PCI)

*Kokov L.S.[1,2], Lopotovsky P.Yu.[1,2] *, ParkhomenkoM.V.[1], LarinA.G.[1], KorobeninA.Yu.[1]*

[1] *N.V. Sklifosovsky Institute of Emergency Medicine*
[2] *Department of X-ray Diagnostics, I.M. Sechenov First Moscow State Medical University, Moscow, Russia*

We present a review of our experience with the use of bivalirudin in 35 patients with acute coronary syndrome (ACS).
The study was aimed at the assessment of possible efficacy and safety of using Angiox during high risk interventions or percutaneous coronary interventions (PCIs) with already developed complications.
The administration of the drug after the development of no-reflow or slow-reflow syndrome in 18 patients resulted in improved antegrade blood flow in all cases. The drug was preventively administered in 17 patients at high risk of no-reflow or slow-reflow syndrome development; this may have allowed them to avoid complications, such as distal microembolism, and to achieve antegrade blood flow in a symptom-related coronary artery (TIMI-3). No significant bleeding was registered during the intake of bivalirudin.
A clinical case of treating a patient with acute coronary syndrome caused by acute thrombosis of the coronary artery is presented in the article.
Ключевые слова: *acute coronary syndrome, acute myocardial infarction, percutaneous coronary intervention, Angiox, bivalirudin, no-reflow, slow-reflow, thrombosis.*

During percutaneous coronary interventions (PCIs), endovascular surgeons often face such complications as distal arterial embolism, occlusion of the side branches, as well as no-reflow and slow-reflow phenomena, i.e. the absence or significant slowing of antegrade blood flow in the artery after restoring its lumen (1).

No-reflow phenomenon, according to the opinion of a majority of investigators, is caused by arterial spasm and/or embolism of its microcirculatory bloodstream by the finest particles of the thrombus and/or a plaque squeezed through the stent meshes after its implantation. For treatment of such complications, vasodilators, such as nitroglycerin or isoptin, as well as anticoagulants and intravenous (i/v) platelet aggregation inhibitors (integrilin and monafram) are initially administered intracoronary.

Currently, endovascular surgeons are using Angiox (bivalirudin); however, its efficacy in complicated PCI cases has not yet been widely investigated and described in the national publications.

Angiox (Bivalirudin) is a synthetic polypeptide, a selective direct thrombin inhibitor. In vitro studies demonstrated that bivalirudin inhibits both soluble (free) and fibrin-bound thrombin. I.e. it not only prevents thrombus development, but also, possibly, affects the developing thrombus and, therefore, its use is of special interest during the abovementioned situations (2).

The drug was first approved in New Zealand in 1999. During the period of development and use of the drug, over 40,000 patients from different countries worldwide participated in the clinical studies of this drug. To sum up the results of these studies, it may be said that bivalirudin is as effective as unfractionated heparin and also the combination of heparin with glycoprotein IIb/IIIa inhibitors; moreover, it is more safe in comparison with these agents (3).

However, it is unclear whether these data are enough to justify routine prescription of the drug which is not very often used in the clinical practice assuming that the incidence of acute stent thrombosis during the correct intake of platelet aggregation inhibitors does not exceed 1–2% according to available data (4, 5), and the incidence of significant bleedings does not exceed 2.8% (6, 7).

* *Address for correspondence:*
Dr. Pavel Lopotovsky
N.V. Sklifosovsky Institute of Emergency Medicine
Russia, 129010, Moscow, Bolshaya Sukharevskaya pl., 3
E-mail: lopotovski@mail.ru
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Table 1. Antegrade intracoronary blood flow in ACS patients during the PCI, prior to and after Angiox administration over time

Angiox administration	ACS		TIMI antegrade blood flow: at the baseline/ after the PCI/ after i/v Angiox				Involved artery		
	with *ST* elevation	without *ST* elevation	0	I	II	III	LAD	LCX	RCA
Prior to the stenting (preventively)	11	6	–/–/–	–/–/–	2/2/–	15/15/17	15	–	2
After the stenting (in case of no-reflow)	16	2	6/13/–	–/5/–	2/–/3	8/–/15	13	1	4

Taking this into consideration, we decided to use Angiox not on routine basis, but only during high-risk interventions or in case of such complication of the coronary arteries stenting as no-reflow phenomenon.

We investigated a group of 35 patients, 18 of which had no antegrade filling of the vessel (no-reflow symptom) after the stenting of the coronary artery. In additional 17 patients Angiox was administered preventively prior to the intervention if the lesion morphology suggested development of no-reflow phenomenon or distal embolism of the stented artery. All patients had ACS: 27 subjects had ST-elevation acute myocardial infarction (STEMI), and 8 – non-ST elevation acute myocardial infarction (NSTEMI) of 2-48 hours duration. Thrombolytic therapy at pre-hospital stage has been performed with positive effect in 8 patients. Prior to coronary angiography, all patients were given a loading dose of clopidogrel (600 mg); they also were administered heparin at a total dose of up to 100 U/kg either at pre-hospital stage or after admission.

Antegrade blood flow in patients prior to the procedure, during its conduction and on its completion is presented in Table 1.

It should be noted that no-reflow syndrome did not occur in 17 patients who were administered Angiox to prevent possible complications. Fifteen of them had extended critical stenosis of the left anterior descending artery at the baseline, the signs of thrombosis were present in 4 subjects. Good stenting results and TIMI-3 antegrade blood flow were obtained in all cases. Moderate deceleration of antegrade blood flow with no clinical symptoms was observed in 2 cases.

In 2 patients from this group, occlusion of the diagonal branch within the stenting zone occurred after the stent implantation into the LAD (this could not be avoided due to the lesion morphology). They also got additional Angiox after heparin administration according to the standard regimen (as in ACS). After that, blood flow in the arteries was restored.

However, the main objective of our study was to answer the following question: whether the additional administration of Angiox in patients with already developed no-reflow phenomenon can improve antegrade blood flow in the stented artery. Such situation was observed in 18 patients (13 cases of TIMI-0, 5 cases of TIMI-1). All patients were administered intracoronary nitroglycerin solution at a dose of 50 μg to relieve the spasm; however, besides nitroglycerin, Angiox at a dose of 0.75 mg/kg was administered intravenously with subsequent infusion at a rate of 1.75 mg/kg/hour. In all 18 cases positive blood flow dynamics was observed. Thus, 10 minutes after Angiox administration, TIMI-3 antegrade blood flow was restored in 15 patients. Blood flow in three patients with no-reflow phenomenon (TIMI-0 blood flow) at the baseline improved to TIMI-2. In none of the cases complete absence of positive changes was observed.

No in-hospital mortality was registered among our patients; all patients were discharged from the hospital within 14 days. No cases of acute stent thromboses, strokes, myocardial ischemia recurrences were also reported.

The introducer was removed from the femoral access site within 4–24 hours after the intervention. Two patients had significant subcutaneous hematomas at the puncture site which did not result in significant decrease of hemoglobin level, and, therefore, they did not require hemotransfusion. Meanwhile, heparin was also used in the patients. Angiox administration did not cause any additional bleeding in our patients.

Therefore, despite the fact that Angiox in some patients was administered not preventively but after no-reflow phenomenon development and previous heparin administration, good angiographic and clinical result was obtained and no additional complications were reported.

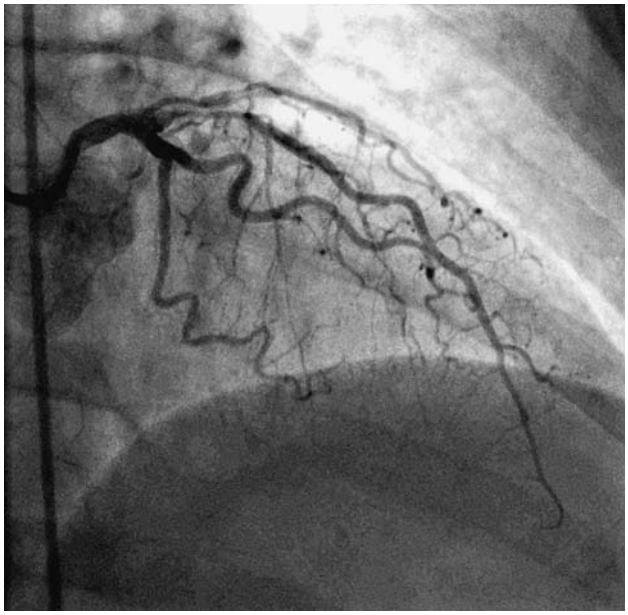

Figure 1. Baseline coronary angiogram of the female patient with AMI. Stenosis of the LAD and DB.

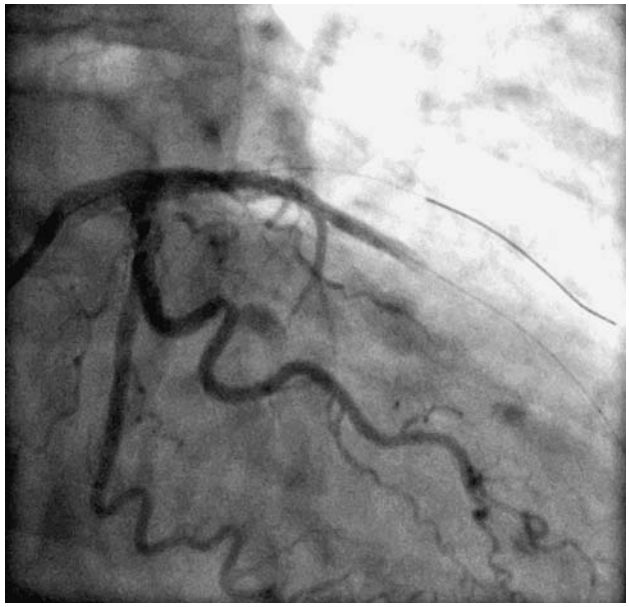

Figure 2. Coronary angiogram immediately after the stenting. No-reflow phenomenon. Complete absence of blood flow in the DB and propulsive slowed blood flow up to the middle third of the LAD.

Clinical case

A 76-year-old female patient was admitted into the department with acute anteroseptal myocardial infarction within 6 after the onset of symptoms; at pre-hospital stage she received thrombolysis with a full dose of Actilyse. At admission, the effect of thrombolysis was assessed as positive; however, considering residual precordial pain and unstable hemodynamics, it was decided to perform urgent coronary angiography. Prior to coronary angiography, 5,000 U of heparin were administered through the sheath. Coronary angiography revealed stenosis of the proximal segment of the LAD, involving a large diagonal branch which was stenosed from the orifice (Figure 1). TIMI-3 blood flow in the artery was observed with insignificant deceleration.

Angioplasty of the orifice of the diagonal branch was performed; then, the stent was placed in the proximal third of the LAD. Immediately after the stent implantation, no-reflow phenomenon occurred (Figure 2) accompanied by the pain syndrome which required administration of narcotic analgesics. Considering very high risk of prescribing IIb/IIIa inhibitors after recently conducted thrombolysis, it was decided to use bivalirudin.

Angiox was administered by the following regimen: as i/v bolus at a dose of 0.75 mg/kg with subsequent immediate continuation of infusion at a rate of 1.75 mg/kg/hour until completion of the procedure.

Control examination performed in 10 minutes revealed patent artery, TIMI3 antegrade blood flow was achieved, the pain syndrome was managed (Figure 3).

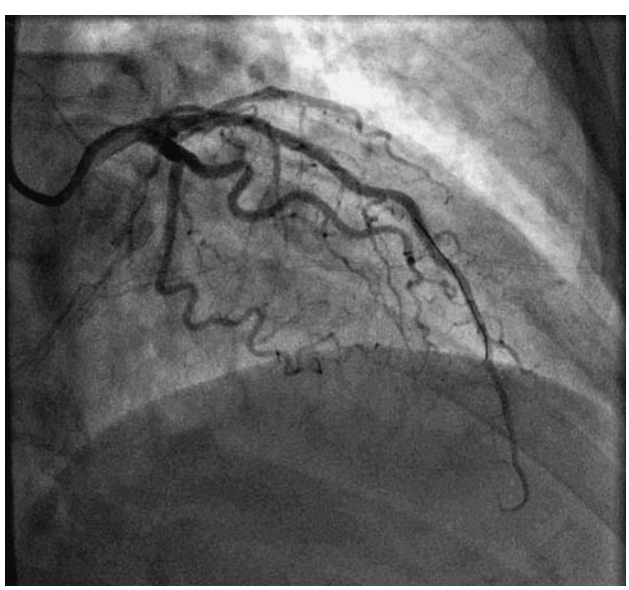

Figure 3. Control coronary angiogram in 10 minutes. Restoration of antegrade blood flow.

Our study without the control group does not claim to make any far-reaching conclusions and recommendations. However, it may come to attention of specialists, and, probably, when the greater experience of Angiox use is gained, in particular, during high-risk interventions and intracoronary complications which developed as a result of such interventions, its efficacy will be proved, and indications for its use will be expanded.

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Device for Remote Coronary Angioaortography

Kalashnikov K.A., Yanchuk V.P., Zmerenetsky K.V.*

Sergueev Regional Clinical Hospital (RSBHI RCH) No1, Institute of Postgraduate Medical Education, Khabarovsk, Russia

The suggested device for remote coronary angiography allows to increase the amount of endovascular interventions without increasing medical staff and to minimize the surgical team's exposure. This, in turn, helps to use expensive medical equipment in a more effective way.
Key words: *coronary angioaortography, remote technique.*

Intruduction

Wide implementation and expansion of endovascular techniques led to a significant increase of the number of diagnostic and treatment interventions. This made us to think about individual measures to protect endovascular team from X-ray exposure. Thus, the average amount of coronary angiographies in Russia is 133,039 per year, with about 700,000 examinations of the aorta and the lower extremities per year (1)

Purpose of the work – To assess the dose of X-ray radiation received by medical staff during endovascular interventions, and to propose the method for improving coronary angioaortography performance.

Technique

In an effort to increase the capacity of X-ray operating room equipped by angiography apparatus without concomitant increase in staff's radiation exposure, Dr. Konstatin Kalashnikov from the Department of Endovascular surgery of Prof. S.I. Sergeev Regional Clinical hospital N1, together with associate professor V.Yanchuk, employee of Khabarovsk Institute of Medical Post-Graduate Education have invented a device for remote coronary angiography and got a "DECISION about invention patent delivery" dated July 03, 2013. The device for remote coronary angiography has been manufactured by S.V. Belov, medical engineer of Prof. S.I. Sergeev Regional Clinical hospital N1.

* *Address for correspondence:*
Kalashnikov K.A.
Russia, 680023, Khabarovsk, Khabarovsk region,
Krasnorechenskaya str. 161a, 144
Tel.: +7-924-113-17-26
E-mail: k.a.k.75@mail.ru
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Due to a system comprising electric engines and reducers, this device allows remote performance of all necessary manipulations related to catheter movement, catheterization of orifice of artery in the area of interest and administration of contrast agent. The interventionist manages this device using a console, while being at a safe distance outside the area of action of X-ray radiation (in the control room). Endovascular interventions are being performed in accordance with the standard technique, through Seldinger arterial puncture in the extremities and the introduction of catheter into the arterial lumen. The arterial ostia in the area of interest are catheterized under X-ray guidance, then after the administration of contrast agent, multipositional evaluation of vascular lesions is carried out. The movements of catheter are guided, as usual, with angiographic machine set in fluoroscopic regimen with real-time image fixation at a screen located in the control room. Movements of table deck and multipositional recording are feasible using a standard remote console in the control room. All these, including data interpretation and decision making, are performed directly during investigation, as with standard coronary angioaortography.

Results

During 2012–2013 we analyzed over 800 various types of endovascular interventions. We assessed the dose of X-ray radiation and investigated the reasons for its increase. The surgical team worked in close proximity to the X-ray source. Depending on the type of examination, the dose of fixed X-ray exposure was over 2 mSv per investigation, the average value being 7 (5) mSv.

It is known that the fact of X-ray use during endovascular intervention can somewhat limit the utilization of the method, as it implies health

Table 1. Main dose limits for staff and population (Regulations on Radiation Safety, RRS-99/2009)

Rated values	Dose limits	
	Group A staff	Population
Annual effective dose of external and internal irradiation, mSv	20 for any 5 years but not more than 50 per year	On average 1 for any 5 consecutive years, but not more than 5
Annual equivalent dose, mSv:		
lens	150	15
skin	500	50
hands and feet	500	50

Notes.
1. Simultaneous irradiation up to specified limits by all rated values is allowed.
2. Dose limits for group B staff are $^1/_4$ values for group A staff.
3. Main limits do not include doses due to natural and medical irradiation and due to radiation accidents.

Table 2. Threshold doses of deterministic effects (ICRP Publication # 60)

Irradiation effects	Single irradiation, Gr (Sv)	Long-term irradiation, Gr (Sv)/year
Temporary sterility in men	0.15	0.4
Permanent sterility in men	3.5–6	2
Permanent sterility in women	2.5–6	0.2
Cataract with decreased vision	2–10	More than 0.15
Clinically detectable depression of hemopoiesis	0.15	0.4
Fetus malformations	0.15	0.4

risk for the patient as well as for the medical staff. Currently, standard protection of surgical team from X-ray exposure is assured by various individual protection means (X-ray aprons, overalls, shields, etc).

The difficulties, and sometimes the inability, for whatever reason, to comply with the generally adopted measures of X-ray safety may lead to the development of skin cancer, cataract, radiation hand lesions of different severity. The existing dose limits for medical staff that may restrain capacity of X-ray operating rooms equipped by angiography installation; main dose limits for staff and population in the Russian Federation are provided in Table 1.

If threshold doses are exceeded, deterministic effects may develop. Dose limits of deterministic effects are provided in Table 2.

The analysis of the obtained data and their comparison with the expected results allowed us to systematize eventual positive effects from the use of the suggested device for remote coronary angiography, which are shown in Table 3.

Our study allows us to believe, that the suggested device for remote coronary angiography makes it possible to increase the number of

Table 3. Comparative characteristics of effects received and expected during coronary angioaortography by standard method and during use of device for remote coronary angiography

	Standard-technique coronary angioaortography	Coronary angioaortography with the use of the device for remote coronary angiography
1	Use of standard X-ray operating room	Use of standard X-ray operating room
2	Use of angiography apparatus with remote console TSSC and Smart Handle (on the example of Innova 3100)	Use of angiography apparatus with remote console TSSC and Smart Handle (on the example of Innova 3100)
3	**Mandatory** use of personal equipment for protection from X-ray radiation (aprons, cap, skirt, shields, glasses)	Use of personal equipment for protection from X-ray radiation (aprons, cap, skirt, shields, glasses) **in full is optional**
4	Artery puncture and insertion of introducer (1 minute)	Artery puncture and insertion of introducer
5	Catheter insertion into the introducer	Catheter insertion **into the device** and the introducer

Table 3 (*ending*).

	Standard-technique coronary angioaortography	Coronary angioaortography with the use of the device for remote coronary angiography
6	**Manual** intraluminal catheter advancement to the arterial ostium of the area of interest **under X-ray guidance (surgeon is within X-ray coverage)**	Intraluminal catheter advancement to the arterial ostium in the area of interest **under X-ray guidance using the device (presence of surgeon within X-ray coverage is not required)**
7	Administration of contrast agent and multipositional imaging of arteries in the area of interest are performed **manually under X-ray guidance (surgeon is within X-ray coverage)**	Administration of contrast agent and multipositional imaging of arteries in the area of interest are performed **using the device (presence of surgeon within X-ray coverage is not required)**
8	Assessment of lesion area and calculation of required consumables if necessary	Assessment of lesion area and calculation of required consumables if necessary
9	**X-ray exposure of surgery team with use of personal protective equipment from 2 mSv** (should not exceed 50 Sv/year)	**X-ray exposure of surgery team is minimal**
10	Use of X-ray protective gloves is **difficult** due to their constructive peculiarities (dose of X-ray irradiation should not exceed 500mSv/year)	**Not required**
11	As a rule, **feet protection** is not used (X-ray exposure should not exceed 500 mSv per year)	**Not required**
12	Use of X-ray protective glasses **for eyes protection** (X-ray exposure should not exceed 150 mSv per year)	**Not required**
13	Increase in number and duration of investigations may be **restrained due to X-ray exposure limits** for the staff	Not restrained
14	Limitation of investigation number due to maximum permissible X-ray doses may lead to **downtime** of expensive medical equipment.	**Operation in full**
15	Technique of investigation does not provide for further modernization.	In future, use of device may lead to **automation** of coronary angioaortography process, development of devices for remote **stenting** of damaged arteries.

endovascular interventions without increased medical staff, as well as to minimize negative X-ray impact on surgery team. This, in turn, will lead to more effective use of expensive medical equipment.

The device developed is a prototype and requires further collective adaptation by endovascular specialists of our country and by large companies-manufacturers of medical equipment. At present we are studying the possibility of manufacturing a device allowing to perform not only diagnostic, but also therapeutic endovascular interventions on major vessels in the human body.

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The 1st International Course "Modern Trends in the Treatment of STEMI – from Guidelines to Daily Practice"

The 1st International Course "Modern Trends in the Treatment of STEMI – from Guidelines to Daily Practice" has been held on September 26–27, 2013, in Moscow, in the World Trade Center. The Course was organized by Russian Society of Interventional Cardioangiology and Moscow City Center of Interventional Cardioangiology. Eminent cardiologists from all over the world have participated in the work of the Course: A. Colombo (Italy), C. Grines, A. DeMaria and S. Mehta (USA), M.-C. Morice and J.-Ch. Vernhet (France), C. Naber and C. Nienaber (Germany), A. Erglis (Latvia), Russian specialists – D. Iosseliani, L. Kokov, S. Semitko, A. Koledinsky (Moscow), A. Osiev (Novosibirsk), V. Ganiukov (Kemerovo), et al.

The Course was aimed at the improvement of skills of young specialists working in the field of endovascular management of STEMI, as well as at the exchange of opinions on modern principles and approaches to the most effective myocardial reperfusion in this disease. One can rightfully speak about the unique and original nature of this Course, as it has been accompanied by continuous on-line live case demonstration of endovascular procedures in STEMI patients brought to Moscow City Center of Interventional Cardioangiology by emergency teams within the first hours after the onset of the symptoms during the Course' sessions. In total, during two days 9 live cases have been demonstrated. During the procedures the operators have used various options of myocardial reperfusion, including in patients after pre-hospital thrombolysis.

It is worth noting that the organization of such courses with on-line live case demonstration of endovascular management of STEMI is very difficult in the majority of countries, due to the decentralized system of emergency care. For this reason one can cite just single examples of such conferences. Numerous attempts of live case demonstration from the operation rooms were mostly unsuccessful. Meanwhile the system of organization of pre-hospital care for AMI patients in Moscow and in Russia in whole allows for the regulation of patients' flows in given hospitals, thus creating favorable circumstances for target admission of AMI patients in specialized medical institutions.

Through this process it became possible to conduct a successful course with unprecedented number of operated patients – 9 cases of STEMI! All participants of the Course gave high appreciation of the skills and professionalism of the operating teams that included Doctors S. Semitko, A. Koledinsky, O. Sukhorukov, I. Kovalchuk, D. Asadov and nurses I. Triasina, I.Torshina, N. Komissarova, I. Nilova, O. Khlopkova, Yu. Timonina, V. Volkova.

It is also worth noting that the operations were accompanied by continuous dialogue and discussion between the conference hall and the operating room, thus allowing to each of the participants to present his or her opinion concerning the optimization of reperfusion procedures in patients with AMI.

The scientific part of the Course has been equally important. During two days the audience had the opportunity to listen the presentations of world-known experts on the problem of STEMI.

Co-director of the Course, Director of Moscow City Center of Interventional Cardioangiology David Iosseliani presented the experience with the management of STEMI. The principles of this disease' treatment applied in Moscow City Center allowed to decrease STEMI-related mortality to 2–3%, which is comparable with the best results of the leading world clinics. The lecturer gave his recommendations on the most effective methods and tactics of STEMI management for the young specialists.

American cardiologist Sameer Mehta gave a detailed description of the news ways of improving the outcomes in STEMI interventions and told the audience about the experience in this field accumulated in Los Angeles.

The presentation of the outstanding Italian cardiologist and researcher Antonio Colombo was focused on the problems related to the prevention of coronary arterial embolism during PCI. Besides, Professor Colombo gave a comprehensive description of MGuard stents, used for the prevention of this severe complication

The panel (left to right) : Andrejs Erglis (Latvia), Sameer Mehta (USA), David Iosseliani (Russia).

A new patient's coronary angiogram appears on the screen. The panel (left to right) : Andrejs Erglis (Latvia), Sameer Mehta (USA), David Iosseliani (Russia), Marie-Claude Morice (France), Christoph Nienaber (Germany).

The audience of the Course.

The Course attendees from Russia (left to right): Leonid Kokov, Serguey Semitko (speaking), Vladimir Ganiukov.

and shared his experience with the use of these stents in clinical practice.

The lecture of Co-Director of the Course, Dr. Cindy Grines from Detroit Medical Center dedicated to the problem of the choice of stent for endovascular myocardial reperfusion in STEMI patient, aroused much interest of the audience.

Cardiogenic shock is the severest complication of acute myocardial infarction, and until recently shock-related mortality was as high as 80–90%. However after broad introduction of endovascular myocardial reperfusion into the clinical practice the rate of mortality significantly decreased, and at present is about 50%. The aspects of the most optimal strategies of myocardial reperfusion in the settings of cardiogenic shock were highlighted by the eminent French cardiologist, Professor Marie-Claude Morice.

The second presentation of Antonio Colombo focused on conceptually new stents – polymer-free DES Cre8. The lecturer described the details of technology, the data of the last clinical trials, the possibilities of this stent's use in patients with AMI and presented the first clinical results.

The organization of medical care for AMI patients is quite different in metropolises and cities as compared to the rural area, and just for this reason the audience took a great interest in the presentation of the well-known German cardiologist Dr. Christoph Nienaber. He gave a comprehensive description of myocardial infarction referral networks in rural areas of Germany and showed that along with some difficulties, this system has a lot of advantages, in particular, if a specialized hospital able to provide high-technological medical care is available in the vicinity. The patients can be referred to such hospitals within minutes, which is very important in the settings of acute myocardial infarction.

The second day of the Course started with the most interesting lecture of Dr. Cindy Grines on the management of massive thrombi and thrombosis-related complications of myocardial blood supply in AMI. The lecturer presented the most effective options for the prevention of such complications and current methods of management of coronary arterial thrombosis and no-reflow.

An interesting know-how was presented by Moscow cardiologist, Dr. Anton Koledinsky. Together with his co-authors he has elaborated an original technique patented in Russia and aimed at the prevention of reperfusion injury of

Live case from the cathlab of Moscow City Center of Interventional Cardioangiology. The operator – Dr. Oleg Sukhorukov.

The expert's opinion. David Iosseliani (Russia) and Marie-Claude Morice (France).

Live case from the cathlab of Moscow City Center of Interventional Cardioangiology.

The audience follows the live case from the cathlab of Moscow City Center of Interventional Cardioangiology.

the myocardium during primary PCI. It is well-known, that along with favorable impact, myocardial reperfusion has some side effects – the reperfusion itself can cause cardiomyocytes' death. Intracoronary administration of cardiocytoprotectors Neoton and Mexicor allowed the authors to significantly limit reperfusion injury of the myocardium.

Dr. Anthony DeMaria from San-Diego, an outstanding American cardiologist, Co-Director of the Course, Editor-in-Chief of the leading cardiological journal in the USA – Journal of American College of Cardiology – presented a lecture on a very important problem – non-invasive evaluation of the condition of the myocardium and of its perfusion. A special place in his presentation was given to contrast echocardiography – this method is very effective for the evaluation of myocardial perfusion and reperfusion, in particular, in AMI patients. Unfortunately, up to now this method is practically non available in our country.

Dr. Vladimir Ganiukov from Kemerovo presented an interesting account on the realization of the initiative of European Society of Cardiology "Stent for Life" in Siberia. This initiative is aimed, on the one hand, to the popularization of the technique of coronary arteries' stenting, and, on the other hand – to the receiving of support from ESC for free-of-charge supply of stents to the hospitals of various countries.

Another Co-Director of the Course, a well-known Latvian cardiologist DR. Andrejs Erglis presented a lecture "Eventual ways for the improvement of the management of postinfarction heart failure: from regenerative medicine to new devices". He gave a detailed account of current potentials of experimental and clinical medicine in the management of heart diseases, in particular, of postinfarction heart failure – from stem cell therapy to artificial heart.

Interesting data on the prevention of distal embolism of infarct-related artery have been presented by Dr. Serguey Semitko, who analyzed a big experience accumulated in his department. Second presentation of Dr. Semitko was focused on the results of a pilot randomized comparative study of Revelyza and Actilyse use on patients with AMI.

Each session ended by Round table discussions, and all the attendees could participate in them along with the invited experts. The following topics were offered for discussion:

- Pre-hospital systemic thrombolysis – in which cases it is reasonable?

• What is the deadline for performing systemic thrombolysis after the onset of symptoms?

• Role of intraaortic balloon pumping and Impella in the treatment of acute myocardial infarction, complicated by cardiogenic shock.

• Should we perform urgent coronary angiography in the presence of clinical and electrocardiographic signs of successful prehospital systemic thrombolysis?

• When it is worth performing angioplasty of IRA after successful thrombolysis confirmed by urgent coronary angiography?

• Should we aim at complete myocardial revascularization or at blood flow restoration only in the IRA when performing urgent procedure?

• When will you perform thrombus extraction?

• Do you consider promising the use of intracoronary pharmacological therapy in general and, in particular, of cytoprotectors, in STEMI?

• Tactics of double antiplatelet and thrombolythic therapy in STEMI patients.

• What is time interval after the onset of AMI when urgent endovascular procedure becomes unreasonable?

• What is your preference for stenting in STEMI – bare metal stent, DES, or maybe scaffolds?

• When it is optimal to discharge the STEMI patients?

• Is it necessary to perform stenting in the presence of stent-like effect after balloon angioplasty or thrombus extraction

• When it is reasonable to return to work after STEMI?

• Maybe you can tell us about some new trends in the treatment of STEMI, that were not included in our topics for discussion?

The Round tables provoked a vivid interest of the audience, and all the attendees actively participated in the discussion of suggested topics.

In total, over three hundred physicians attended the Course.

During the final session it was decided to acknowledge the success and the effectiveness of the Course. The second Course will take be held in the same place and approximately in the same dates.

Russian Society of Interventional Cardioangiology and the organizing Committee of the 1st International Course “Modern Trends in the Treatment of STEMI – from Guidelines to Daily Practice” are sincerely grateful to the partners who have contributed to the organization of the event:

General Sponsors – companies “Johnson & Johnson”, “Implanta”, “Cardiomedics”, “Medtronic”, “Raymed”, “Terumo”;

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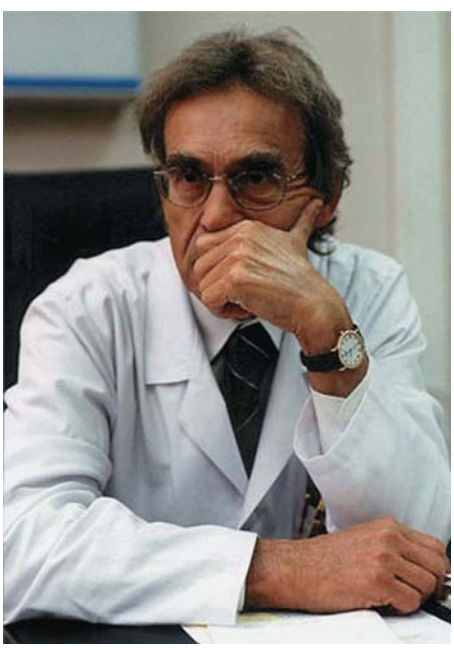
CONGRATULATIONS!

80th Anniversary of Alexander Konovalov



The eminent Russian physician and researcher, one of the founders of modern national neurosurgery, Academician, Hero of Labor of the Russian Federation, the winner of State prizes of the USSR and Russia, Alexander Konovalov turned 80. For many years he is the Director of Burdenko Research Institute of Neurosurgery, Head Neurosurgeon of the Ministry of Healthcare of Russia, Head of the Chair of pediatric neurosurgery of Russian Medical Academy of Postgraduate education, Professor of Pirogov Russian National Research Medical University, President of the Association of Neurosurgeons of Russia, Vice-President of World Federation and European Association of Neurosurgical Societies. Academician Alexander Konovalov is not only the highest-level professional, but also a great Citizen, a sensitive, warm-hearted and kind person.

Russian Society of Interventional Cardioangiology and the Editorial Board of the Journal wishes Academician Konovalov many years of health, happiness and further creative success.