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Backed into a Corner: ST-Elevation Myocardial Infarction with No Good Therapeutic Options

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Abstract

Primary percutaneous coronary intervention (PCI) is recommended in the majority of cases of ST-segment myocardial infarction (STEMI). Nevertheless, failed PCI remains not very uncommon, yet it is associated with unfavorable long-term clinical outcomes. Management of the failed PCI may include emergency coronary artery bypass grafting (CABG) or the administration of either systemic or intracoronary fibrinolysis. However, clinical utility and benefits for the patients treated with either option are uncertain. Herein, we present a case report of a patient admitted to the Department of Cardiology due to lateral wall STEMI, after cardiac arrest and successful cardiopulmonary resuscitation with coronary anatomy not amenable to PCI and contraindications to fibrinolysis as a clinical scenario with potentially no good therapeutic option.

Introduction

The latest 2023 European Society of Cardiology guidelines uphold the well-known and widely accepted recommendation to revascularize percutaneously patients presenting with ST-segment myocardial infarction (STEMI) immediately, described as primary percutaneous coronary intervention (PCI) within 120 minutes post first medical contact or fibrinolysis if a delay of the PCI exceeding this predefined time period is expected (class of recommendation I, level of evidence A) [1]. Additionally, if the first medical contact occurs in the PCI-capable center, the target time to crossing the culprit lesion with an angioplasty wire should be below 60 minutes. However, in late presenters with STEMI, i.e. over 12 hours post symptoms onset, PCI should be performed in case of hemodynamic instability, symptoms suggestive of ongoing ischemia or if life-threatening arrhythmias are detected (class I C) [2]. Cases with longer delay of the patient's referral to the emergency department require individual assessment, however PCI should be considered within 12-48 hours after symptoms onset (class IIa C) [3]. Cases of STEMI complicated with out-of-hospital cardiac arrest (OHCA) should be diagnosed invasively and treated with primary PCI accordingly (class I B) [4] but invasive coronary angiography is not recommended routinely if electrocardiography (ECG) reveals no ST-segment elevations (class III A)[5].

Coronary artery bypass grafting (CABG) as an emergency procedure in patients with STEMI may be performed in case of unfavorable anatomy for PCI or if mechanical complications of the myocardial infarction are confirmed but revascularization is still required. On the other hand, clinical benefits of a bailout CABG in case of failed PCI is not supported with strong evidence, therefore it is rarely performed. Potential drawbacks of such procedure include non-negligible delay of surgery and significantly increased perioperative risk [6]. Herein, we present a clinical case of a patient with a diagnosis of lateral wall STEMI and coronary anatomy not amenable to PCI.

Case Description

A 61-year-old male, with the history of thoracic aortic aneurysm (TAA) diagnosed in 2000, coronary-pulmonary shunts visualized first in coronary angiography in 2001, prior cerebral contusion resulting in post-traumatic epilepsy (1983), was admitted to the Department of Cardiology due to the lateral wall STEMI. At admission, the patent suffered from recurrent episodes of diffuse burning chest pain coexisting with marked dyspnea. Prior to the admission, the patient referred to the Emergency Department in his hometown hospital due to physical activity impairment caused by the episodes of typical stenocardia corresponding with Canadian Cardiovascular Society (CCS) class II. Owing to the history of TAA, the patient underwent computed tomography of aorta, where acute dissection was ruled out. Nevertheless, progression of the diameter of TAA was observed in comparison with the previous available result (54 mm in 2014, 64 mm currently). Additionally, in the transthoracic echocardiography a significant reduction of left ventricle ejection fraction (LVEF=15%) was diagnosed. In the face of that, the decision to transfer the patient to A. Jurasz No.1 University Hospital in Bydgoszcz for an urgent cardiac surgeon consultation was made. Initial physical examination performed in the Emergency Department of A. Jurasz Hospital revealed resting dyspnea, accelerated heart rate – 110 bpm, bilateral congestion over the lower parts of lungs, mild peripheral edema. According to the consulting cardiac surgeon, there were no definite traits of a rapid progression of TAA. Moreover, no certain correlation between TAA and presented symptoms and signs was established, so the patient was not qualified for an immediate surgical intervention. Additionally, the patient did not consent to undergo open-chest surgery at that moment. Directly before the transfer back to the referring hospital, the patient experienced cardiac arrest in the mechanism of ventricular fibrillation. The return of spontaneous circulation (ROSC) was achieved after a single defibrillation and one cycle of cardiopulmonary resuscitation. The patient's condition stabilized and no signs of acute heart failure were observed.

ECG recorded shortly after the ROSC revealed traits of lateral wall STEMI (Figure 1), thus the patient was immediately transferred to the catheterization laboratory of the Department of Cardiology. Coronary angiography was performed via right radial artery using standard 5F catheters – Judkins Left 4.0 and TIG 4.0. In the angiography, arterial shunts between proximal portion of the right coronary artery (RCA), pulmonary artery and medium portion of left anterior descending artery (LAD) were found. No significant lesions were visualized in the RCA. Nevertheless, major abnormalities of the left coronary angiography (LCA) were observed. Firstly, a significant dilation of the left main (LM) with large shunts between proximal segments of LCA and pulmonary artery were found. Secondly, a total occlusion of the medium segment of LAD with the congestion of the contrast medium was evident (Figure 2a, 2b). Based on the obtained result, an immediate attempt to revascularize the LAD was undertaken with the use of 6F Medtronic Launcher Extra Backup catheter (EBU 3.75), and two workhorse angioplasty wires Asahi Sion Blue J. Despite major efforts, only proximal portion of LAD could be crossed with the wire. The other wire was successfully placed in the diagonal branch.

After initial mild inflations of the Boston Scientific Emerge 2.0x15 mm semi-compliant angioplasty balloon, the flow through the diagonal branch was only partially restored. No improvement was observed in the area of LAD (Figure 3a, 3b). After the unsuccessful procedure the patient was consulted by the cardiac surgeon again with the idea of bailout coronary artery bypass grafting (CABG), but he was not qualified for the procedure due to no definite landing zone in distal portions of both LAD and diagonal branch in the angiography and prohibitive perioperative risk. Ultimately, the patient was qualified for conservative treatment.

Table 1: Baseline laboratory parameters.

Parameter	Upper Reference Value	Result
RBC [T/L]	4.63-6.08	4.82
WBC [G/L]	4.23-9.07	**17.28**
HCT [%]	40.1-51.0	47.4
Hgb [mg/dL]	13.7-17.5	15.8
PLT [G/L]	132-370	259
MCV [fl]	79-92.2	98.3
MCH [pg]	25.7-32.2	32.8
MCHC [g/dL]	32.3-36.5	33.3
Total bilirubin [mg/dL]	0.2-1.2	2.20
Uric acid [mg/dL]	3.7-7.7	5.6
Total Calcium [mmol/L]	2.2-2.5	2.34
CRP [mg/L]	< 5	10.65
HbA1c [%]	< 5.7	5.8
Glucose [mg/dL]	70-99 (*)	155
Na [mmol/L]	136-145	141.9
K [mmol/L]	3.5-5.1	4.5
Cl [mmol/L]	98-107	108.5
Creatinine [mg/dL]	0.7-1.2	0.78
eGFR [mL/min]	>60	97.63
ALT [U/L]	< 49	96
AST [U/L]	< 34	**1019**
Apolipoprotein B [mg/dL]	**	69
Total cholesterol [mg/dL]	**	123
HDL [mg/dL]	**	31
TG [mg/dL]	**	82
LDL (calculated) [mg/dL]	**	75
Non-HDL [mg/dL]	**	92
Lipoprotein A [mg/dL]	**	4
INR	0.9-1.2	1.76
APTT [sek]	24-36	34.6
TSH [µIU/mL]	0.41-2.46	2.475
Troponin I [ng/L]	< 34	**172635**
NT-proBNP [ng/L]	< 125	**17340**

Abbreviations: RBC: Red Blood Cell Count; WBC: White Blood Cell Count; HCT: Hematocrit; Hgb: Hemoglobin; PLT: Platelet Count; MCV: Mean Corpuscular Volume; MCHC: Mean Corpuscular Hemoglobin Concentration; CRP: C-Reactive Protein; Hba1c: Glycated Hemoglobin Concentration; Na: Natrium; K: Potassium; Ca: Calcium; Egfr: Estimated Glomerular Filtration Rate; ALT: Alanine Aminotransferase; AST: Asparagine Aminotransferase; HDL: High Density Lipoprotein; TG: Triglyceride; LDL: Low Density Lipoprotein; INR: International Normalized Ratio; APTT: Activated Partial Thromboplastin Time; TSH: Thyroid Stimulating Hormone; NT-Probnp: N-Terminal Pro-B-Type Natriuretic Peptide;

***Reference values for lipid profile assessment have not been inserted in the table as they differ between patients based on the cardiovascular risk.

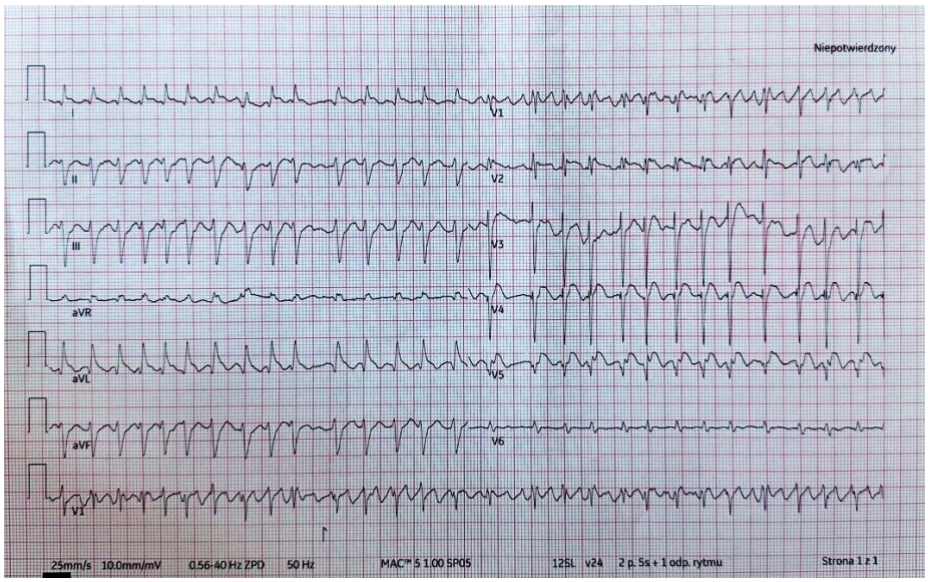

Figure 1: Baseline electrocardiogram of the patient presenting atrial flutter with heart rate around 150 bpm and traits of ST-elevation myocardial infarction of the lateral wall.

Figure 2a and 2b: Baseline coronary angiography presenting coronary-pulmonary shunts, ectasia of the left main trunk and proximal portion of circumflex artery and a total occlusion of left anterior descending artery.

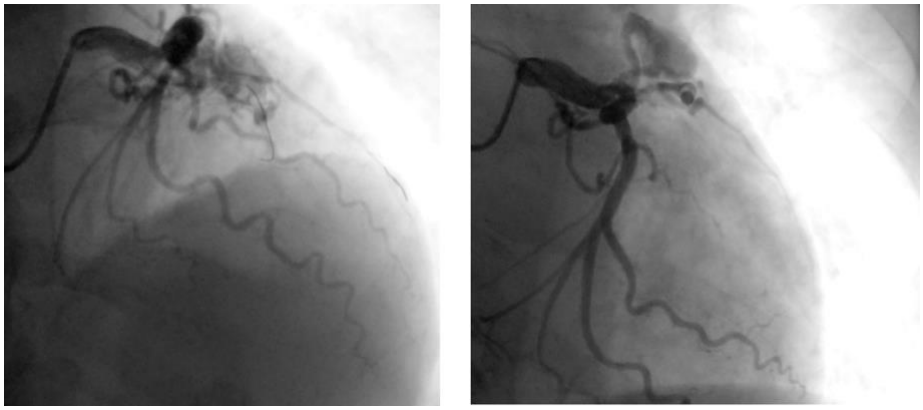

Figure 3a and 3b: Final result of the failed percutaneous coronary intervention. Unsuccessful crossing of the total occlusion in left anterior descending artery and partially restored flow to the diagonal branch.

The laboratory results which became available after the angioplasty revealed significantly increased troponin I concentrations: 172635 ng/L (N<34 ng/L), which decreased in the following assessment around 2 hours post the initial one to 158970 ng/L. Apart from the increased serum troponin concentration, laboratory tests showed significant increase in the concentration of NT-proBNP (17340 ng/L), alanine aminotransferase (96 U), asparagine aminotransferase (1019 U), total bilirubin (2.2 mg/dL). Baseline laboratory tests are presented in Table 1. Multiple pathologies in the echocardiography performed in the Department of Cardiology comprised: akinesia of apical and mid segments of the anterior, inferior, lateral wall and intraventricular septum, hypokinesia of the right ventricle and basal segments of the anterior wall and intraventricular septum, significant impairment of LVEF (18-20%), decreased contractility of the right ventricle, increased pulmonary arterial pressure (SPAP 56 mmHg), moderate mitral and tricuspid regurgitation, dilation of all chambers (left ventricle 62 mm, right ventricle 30 mm, left atrium 54 mm, right atrium 71 mm).

During the following days the patient remained stable, however two days after the admission symptoms of urinary tract infection developed with the significant increase in inflammatory laboratory parameters (c-reactive protein - CRP 139 mg/L, leukocyte count 17.57 G/L). Samples for urine culture were obtained and empiric antibiotic therapy with ceftriaxone was introduced. Additionally, on the same day an episode of hemodynamically stable wide-QRS tachycardia with heart rate 200-220 bpm occurred, so the patient required electric cardioversion. Considering the severity of the LVEF impairment, inoperable coronary artery disease, unsuccessful percutaneous coronary intervention as well as the patient's overall clinical status, the decision to qualify the patient for an implantable cardioverter-defibrillator was made.

Discussion

The presented clinical case of failed PCI due to unfavorable coronary anatomy is not an uncommon scenario in patients presenting with STEMI nowadays. As definitions of a failed PCI may differ, it is generally approved that patent Thrombolysis in Myocardial Infarction (TIMI) 3 flow in the infarct-related artery as well as milder than 50% residual stenosis of the treated segment are considered a procedural success [7]. A study by Levi et al., showed the 5.4% incidence of failed PCI in STEMI patients (94 of 1725 procedures), but the used definition of failure was stringent with residual stenosis of at least 30% in infarct-

related artery [8]. Ultimately, failed PCI in STEMI is associated with unfavorable clinical outcomes including increased in-hospital and long-term mortality, recurrent revascularizations or the development of chronic heart failure. [9,10] Emergency CABG may be required in most severe cases of primary PCI failure, but rates of reported in-hospital and long-term mortality remain high, which makes this approach rather limited [11-13]. Contrary to the case report by Urbanowicz et al., where a patient underwent a successful immediate cardiac surgery after failed PCI due to the entrapment of the angioplasty wire outer layer which was left in LAD and protruded to aortic root [14], in our case the patient was treated conservatively. It needs to be highlighted though, that the disqualification from cardiac surgery might have been driven mainly by undetectable distal portion of LAD in baseline coronary angiography. An alternative, yet commonly omitted, method of dealing with unsuccessful PCI may be systemic or coronary fibrinolysis. Sun et al. reported a case of a successful administration of alteplase in a patient with inferior wall STEMI and ectasia of the RCA after failed PCI [15]. On the other hand, use of intracoronary fibrinolysis has no strong data in the literature, as no definite benefit was found in bailout procedures [16]. In the presented case, we faced the uncrossable lesion in LAD and multiple coronary-pulmonary shunts accompanied with multiple ectatic segments of LCA including LM. Moreover, the patient had a history of central nervous system contusion, post-traumatic epilepsy and recently underwent cardiac arrest with cardiopulmonary resuscitation. Therefore, the decision to avoid systemic or intracoronary fibrinolysis was made.

Conclusion

Failed PCI in the course of STEMI is associated with unfavorable short- and long-term clinical outcomes. Several measures may be undertaken to face the potential complications. Nevertheless, in some complex cases, as presented in the subject scenario, operators and attending physicians are literally backed into a corner with no good therapeutic options left.

Role of Artificial Intelligence in Creating the Content

No parts of the subject manuscript were composed with the use of artificial intelligence.

Ethics Statement

All the materials were anonymized before the publication of the manuscript. The patient provided informed consent for the use of this clinical case for scientific purposes.

Authors' Contribution

PN created the primary version of the manuscript. All the Authors critically reviewed the manuscript, made relevant corrections and approved its final version. JK also provided substantive supervision of the work.

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Conflict of Interest

All the Authors declare no potential conflict of interests regarding the publication of the subject manuscript.

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