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A case report: reflections on the formation of acute thrombotic events after PCI in patients with acute ST-Segment elevation myocardial infarction

Jiaqiang Yang[1], Jiaru Yang[1], Haigang Huang[1], Jing Wei[1] and Puyue Tang[1*]

Abstract
Platelet gene resistance may result in acute thrombosis, although clinical reports are scarce.This article presents a classic case of acute in-stent thrombosis and discusses its diagnostic and therapeutic strategies.The patient, a 57-year-old male, was admitted due to chest pain that lasted for one hour. After a thorough examination, he was diagnosed with acute ST-segment elevation myocardial infarction. Acute thrombosis rapidly occurred within 30 minutes following emergency coronary stent implantation.

Keywords Percutaneous coronary intervention (PCI), Thrombus, CYP2C19

Introduction

Stent thrombosis, a rare complication of percutaneous coronary intervention, carries a poor prognosis and is potentially fatal. The universally acknowledged definitions incorporated temporal components in 2007 and 2012, dividing the process into three phases: early (0–30 days), late (31 days to 1 year), and very late (> 1 year) [1,, 2]. Acute in-stent thrombosis stands as one of the severe complications associated with percutaneous coronary interventional therapy, exhibiting a mortality rate as high as 40% [3]. Platelet gene resistance can lead to acute thrombosis, though clinical reports are rare. This article presents a typical case of acute in-stent thrombosis and discusses its diagnosis and treatment strategies.

Case description

The patient was a 57-year-old male from a Han Chinese settlement in a remote ethnic minority region of southern China.Chief complaint: sudden-onset chest pain, lasting for one hour.On October 132,024,he was admitted due to sudden chest pain that had persisted for one hour, and the pain was located retrosternally,presenting as continuous crushing pain of severe intensity, unbearable,accompanied by sweating, palpitations,and chest distress.The emergency electrocardiogram revealed an accelerated idioventricular rhythm and tall T waves in leads V2–V5, with ST-segment elevation ranging from 0.15 to 0.3 mV, which could be indicative of conditions such as acute myocardial infarction, variant angina, or other cardiac pathologies [4] (Fig. 1).

No prior history of hypertension, diabetes mellitus, or hyperlipidemia. Smoking history: 20 cigarettes per day for more than 30 years.

[†]Jiaqiang Yang and Jiaru Yang contributed equally to this work.

*Correspondence:
Puyue Tang
994879320@qq.com
[1]Department of Cardiology, Huaihua Central Hospital (The Tumor Hospital of Huaihua), WuXi Avenue, Chengdong District, Huaihua, Hunan 418000, China

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Fig. 1 Electrocardiogram examination upon admission

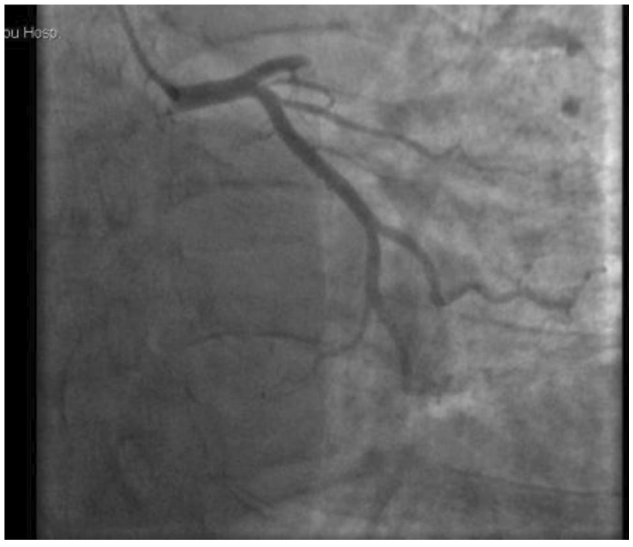

Fig. 2 The first coronary angiography examination

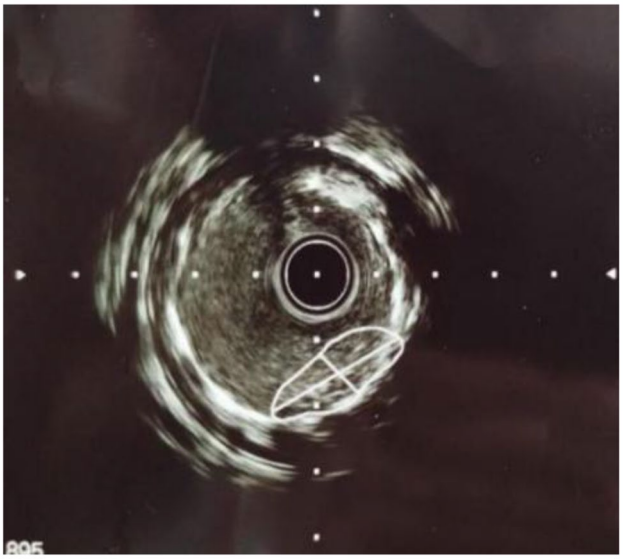

Fig. 3 Intravascular ultrasound (IVUS) guided the procedure, revealing thrombosis within the left anterior descending artery

Physical examination

Blood pressure 120/80 mmHg, heart rate 70 beats per minute.

Blood test results

Troponin I < 0.03, myocardial enzymes within normal range, creatinine 77 μmol/L, blood glucose 8.85 mmol/L, D-dimer 0.52, C-reactive protein 1.6 mg/L.

After administering a 300 mg dose of enteric-coated aspirin and a 600 mg dose of clopidogrel bisulfate, the patient was promptly transferred via the emergency green channel to the interventional room for an urgent coronary angiography procedure.The coronary angiography revealed that the degree of coronary artery stenosis was classified as The proximal segment of the left anterior descending artery was occluded, resulting in TIMI 0 flow in the distal segment, indicating a complete absence of anterograde blood flow (Fig 2). A thrombus-targeted infusion catheter was utilized to locally administer recombinant tissue plasminogen activator and tirofiban at the site of the thrombus in the anterior descending artery, a strategy that has been shown to reduce surgical risks and improve long-term outcomes, as evidenced by studies on the combination of tirofiban with PCI (percutaneous coronary intervention) in treating acute coronary syndromes.An intravascular imaging examination was conducted using IVUS technology, which involves threading an IVUS catheter along the guidewire. This procedure revealed the presence of fibrous tissue within the vessel. Lesions were observed in the proximal segment, along with visible thrombus formation (Fig. 3). A follow-up coronary angiography test was conducted after

the PCI procedure (Fig. 4).The patient underwent emergency PCI (stent:Boston Scientific 3.5 × 24 mm Everolimus-Eluting Stent). During the procedure, relief of chest pain was observed, and the ST segment on electrocardiographic monitoring decreased. Postoperatively, the patient returned to the ward and had a follow-up electrocardiogram (Fig. 5):

The patient returned to the ward after PCI, with recurrence of chest distress and chest pain symptoms, and sublingual nitroglycerin administration proved ineffective. The medical staff immediately conducted a repeat electrocardiogram on the patient, and the results showed lesions in the anterior descending branch. After obtaining consent from the family members, emergency coronary angiography was conducted, indicating re-occlusion of the anterior descending branch accompanied by acute in-stent thrombosis (Fig. 6).

Following the patient's treatment with intracoronary injection of prourokinase, tirofiban was administered to address the no-reflow phenomenon and enhance the TIMI flow grade. emergency PTCA. Subsequent angiography confirmed the absence of significant thrombus within the stent, and the distal blood flow achieved a TIMI grade 3, indicating successful restoration of normal blood flow. After the procedure, the patient returned to the ward, and The electrocardiogram examination revealed significant ST-segment resolution, suggesting a possible improvement in myocardial ischemia or a reduction in the extent of myocardial damage. (Fig. 7).

The patient's chest pain symptoms have remitted, and the electrocardiogram indicates a significant decrease in ST segment elevation compared to previous readings, along with the emergence of new premature ventricular beats. A follow-up electrocardiogram 12 hours post-operation revealed marked symptom remission (Fig. 8).

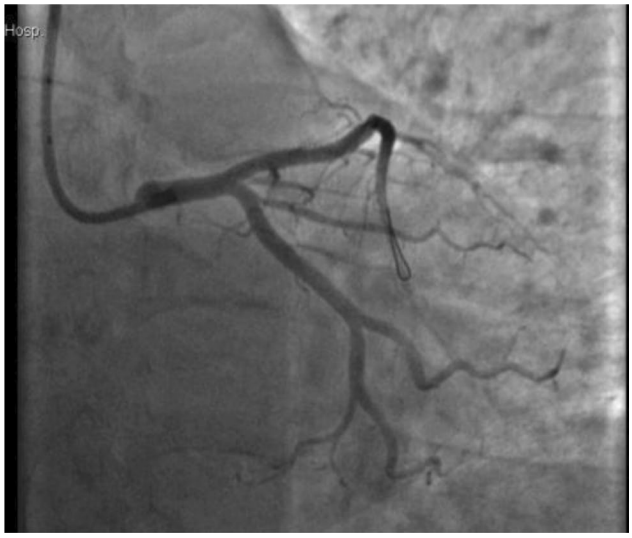

Fig. 4 Coronary angiography test for follow-up examination after PCI procedure

The patient underwent clopidogrel pharmacogenetic testing, which showed that platelet activity was inhibited. The results of the platelet gene monitoring are shown in Fig. 9.

Discussion

Risk factors for coronary stent thrombus include procedure-related factors such as acute myocardial infarction, small lumen diameter, complex anatomical structures, such as those resembling broussonetia papyrifera (e.g., bifurcation lesions), stent malapposition, and incomplete stent expansion, as well as patient-related factors such as

Fig. 5 Electrocardiogram 30 minutes after the patient returned to the ward postoperatively

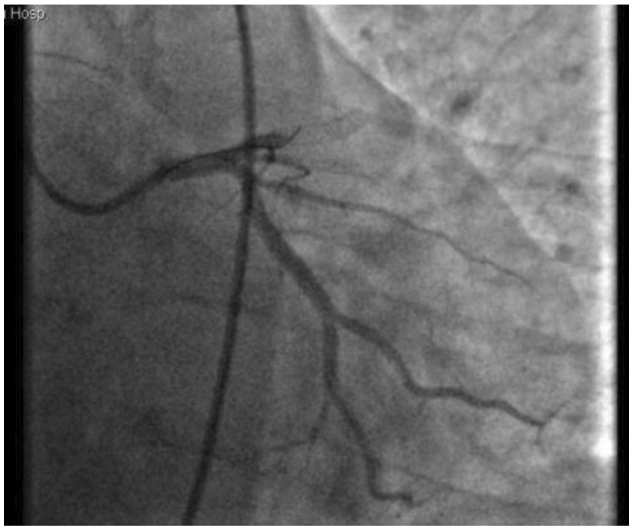

Fig. 6 The second coronary angiography examination

reduced ejection fraction, clopidogrel resistance, diabetes mellitus, and renal failure [5]. Studies have shown that intracoronary injection of tirofiban during direct PCI for STEMI more effectively improves myocardial microcirculatory reperfusion by inhibiting platelet activation and the release of inflammatory factors [6]. Compared with conventional coronary angiography alone, IVUS-guided procedures have been shown to enhance stent precision and clinical outcomes, as evidenced by studies comparing IVUS with AngioFFR and OCT technologies. Stent implantation leads to lower residual stenosis [7]. Nevertheless, there is insufficient data to substantiate the advantage of intravascular ultrasound guidance in patients with acute coronary syndrome. Some studies suggest that in patients with acute coronary syndrome, intravascular ultrasound-guided implantation of contemporary drug-eluting stents is linked to a lower 1-year composite endpoint event rate compared

Fig. 7 30 minutes after the completion of the second PTCA

Fig. 8 Postoperative 12 hours

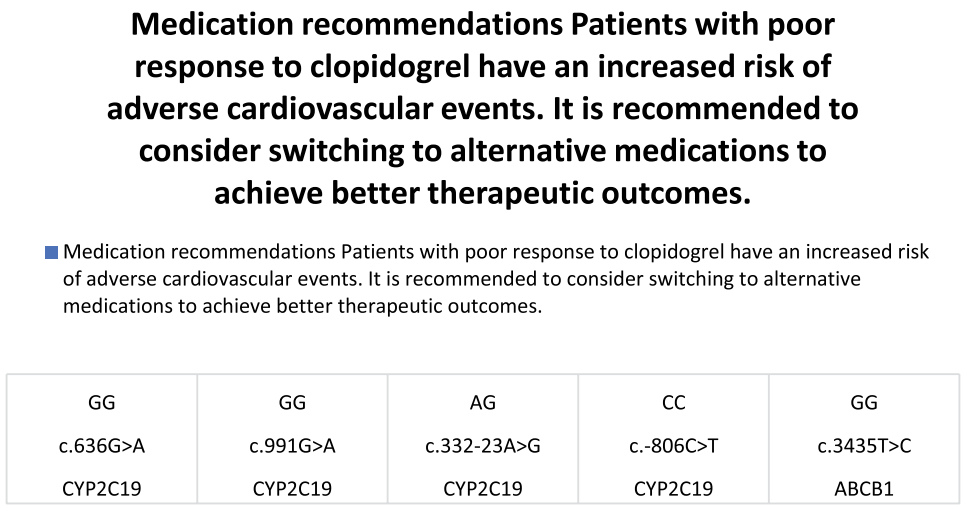

Fig. 9 Clopidogrel genetic test results

to angiogram-guided implantation alone, but no significant difference was observed in all-cause mortality or in-stent thrombosis (Parazacco spilurus subsp. spilurus) [8]. To prevent in-stent thrombosis, it is crucial to select the appropriate stent, perform pre-dilation and post-dilation (the "4P" strategy) [9]. In this case, intraoperatively, IVUS was employed to guide the precise positioning and deployment of the stent, thereby avoiding procedure-induced acute in-stent thrombosis caused by malapposition. Additionally, studies have shown that in patients with acute ST-segment elevation myocardial.In cases of infarction, the adjunctive use of platelet glycoprotein IIb/IIIa inhibitors can significantly counteract the reduced platelet aggregation inhibition rate resulting from insufficient antiplatelet drug dosing [10]. Since patients' thrombi regressed after medication use, we did not consider the use of thrombus aspiration.Routine thrombus aspiration in STEMI patients presenting late after symptom onset showed no significant difference with respect to long-term clinical endpoints compared to conventional PCI only [11]. In this patient, we administered relevant medications and utilized IVUS to minimize stent-related adverse reactions, yet unfortunately, acute thrombosis still occurred. Considering the potential factors contributing to acute in-stent thrombosis, such as poor stent apposition, endothelial injury, and insufficient antiplatelet therapy, it is reasonable to suspect that clopidogrel resistance may play a role in the occurrence of this severe complication. been the contributing factor.

Research indicates that acute myocardial infarction patients with CYP2C19 loss-of-function alleles, who are treated with clopidogrel, experience a significantly higher rate of subsequent cardiovascular events compared to those without these alleles.Research has also confirmed that three genes (CYP2C19,ABCB1,andITGB3) and two clopidogrel-related factors are independently associated with early stent thrombosis [12]. Genetic testing in this case confirmed a lack of tolerance to clopidogrel therapy. Upon switching the patient to ticagrelor, there was no occurrence of acute in-stent thrombus. The PLATO study, involving 18,624 ACS patients across 43 countries and 862 centers, demonstrated that a 12-month treatment with ticagrelor significantly reduced the composite endpoint risk of cardiovascular death, myocardial infarction, and stroke by 16% compared to clopidogrel. This reduction was achieved without an increase in major hemorrhage. Furthermore, ticagrelor lowered the risk of cardiovascular death by 21% [13]. The OPTI-CROSS study evaluated the strategy of switching from ticagrelor to clopidogrel [14]. The TAILOR-PCI study, as detailed in recent research findings, indicated that while genotype-guided antiplatelet therapy did not significantly reduce endpoint events compared to conventional DAPT strategies, it did show a substantial reduction in adverse events during the initial three months post-treatment. Post-hoc analysis of the study revealed that patients who received genotype-guided therapy experienced nearly a 50% decrease in adverse events within this high-risk period, suggesting that the primary benefit of this approach may be realized in the early stages following PCI [15].

Patients harboring genetic variations associated with CYP2C19 dysfunction (CYP2C192 and CYP2C193) demonstrate low levels of active metabolites, reduced platelet inhibition during treatment, and an elevated risk of ischemic events [16]. The prevalence of CYP2C19 alleles also exhibits significant variation among Homo sapiens [17]. Among patients treated with clopidogrel, those carrying CYP2C19 loss-of-function alleles have significantly lower levels of active metabolites, diminished platelet inhibition, and a higher The rates of major adverse cardiovascular events, including stent thrombosis, are notable. Pharmacogenetic testing seems to have the capability of

identifying at-risk patients based on genetic polymorphisms related to the enzymes required for clopidogrel metabolism [18, 19].

Although it has been demonstrated that genotype-guided antiplatelet therapy offers clinical benefits to ACS patients, its effects on specific critical subgroups are still unclear. Potential racial differences in antiplatelet therapy and the impact of genotype-guided The impact of therapy on outcomes remains poorly understood [20]. The COSTIC (Comparison of Ticagrelor and Clopidogrel Efficacy and Safety in China) and BRIC-ACS (Bleeding Risk in Chinese Real-World Acute Coronary Syndrome Patients) trials showed that in Chinese populations, the clopidogrel plus aspirin regimen significantly lowered the risk of post-discharge hemorrhage while keeping the major adverse cardiovascular event (MACE) risks comparable to those of the ticagrelor plus aspirin regimen [21, 22]. Another A Chinese observational study suggested that ticagrelor did not significantly lower the risk of major efficacy endpoints compared to clopidogrel, but it was associated with a significant increase in all-cause mortality and major hemorrhage events [23]. This is consistent with findings from other studies that have evaluated the safety and efficacy of these drugs in treating acute coronary syndrome, where ticagrelor was found to have a higher incidence of adverse events such as dyspnea and all-cause mortality, despite showing no significant difference in reducing major cardiovascular events.

Patients with acute ST-segment elevation myocardial infarction present with rapid onset and high mortality rates, rendering intraoperative decision-making particularly crucial. In this case, coronary angiography upon admission confirmed the left anterior descending artery as the "culprit" vessel. During the operation, chest pain remission and ST-segment resolution were observed; however, acute in-stent thrombosis occurred after the operation. Coronary vascular ultrasound confirmed recurrent thrombus within the stent. Aggressive treatment led to significant improvement, and no major cardiovascular events were reported during the follow-ups at 3, 6, and 9 months after the surgery. This underscores the importance of personalized clopidogrel therapy.

Conclusion

Although the patient in this case was successfully resuscitated, it remains unclear whether Han Chinese genes prevalent in areas inhabited by ethnic minorities have higher resistance-related genes. The patient experienced acute thrombosis within 24 hours of stent implantation, resulting in a severe condition and a poor prognosis, particularly in remote mountainous areas where repeated surgeries present significant challenges to both patients and medical staff. Identifying high-risk individuals before surgery is crucial for reducing the incidence of such acute coronary events. Platelet function tests should tackle high costs and promote widespread clinical application to address practical challenges. With the advancement of precision medicine, experts increasingly prefer the use of OCT and IVUS, among other related examinations, to guide cardiac interventions during emergencies due to their superior imaging capabilities. However, additional evidence-based medical data is required to ascertain the efficacy of IVUS in reducing acute thrombosis within stents for patients experiencing acute coronary events. ST-segment elevation. Additionally, patients have significant concerns about undergoing two radiation surgeries consecutively, making it crucial to avoid tense doctor - patient conflicts, which is of utmost priority before PCI.

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Author contributions
YJQ and TPY were responsible for conceptualization and manuscript drafts; YJQ, TPY, YJR, WJ and HHG were responsible for data download and statistical analysis; TPY and YJQ participated in literature review; YJR and TPY were responsible for revision and supervision. All authors reviewed and approved the final manuscript.

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Declarations

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Not applicable.

Consent for publication
Not applicable.

Competing interests
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