Transradial Artery 5F Outlook TIG Multifunctional Angiography Catheters for Emergency Percutaneous Transluminal Coronary Angioplasty: Two Case Reports

Running title: Transradial artery 5F Outlook TIG multifunctional angiography catheters for emergency PTCA

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Abstract: The key for a successful treatment of acute myocardial infarction (AMI) is timely, efficient, and continuous infarct-related artery (IRA) recanalization for myocardial reperfusion. Emergent percutaneous coronary intervention (PCI) is the first choice of treatment for AMI. Although emergent and elective PCI treatments have similar procedures, emergent PCI is focused on "time is the cardiac muscle, time is life." Interventional physicians have long endeavored to shorten the time between puncture and IRA reperfusion (needle-to-balloon time). In this case report, two patients with AMI were successfully treated. We used transradial artery 5F Outlook TIG multifunctional angiography catheters to perform percutaneous transluminal coronary angioplasty (PTCA) and IRA pre-recanalization. This approach greatly shortened the needle-to-balloon time to 7 min; therefore, IRA was recanalized as early as possible. Ischemic and agonal myocardia were timely reperfused, thereby maximizing patients' benefits. Emergency PTCA was pre-completed using transradial artery 5F Outlook TIG catheters for the two patients who suffered from AMI. This method could be possibly applied in technical and clinical practice. Furthermore, the needle-to-balloon time was effectively shortened.
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1. Introduction

The key for a successful treatment of acute myocardial infarction (AMI) is timely, efficient, and continuous infarct-related artery (IRA) recanalization to initiate myocardial reperfusion. Emergent percutaneous coronary intervention (PCI) is the first choice of treatment for AMI. Although emergent and elective PCI treatments have similar procedures, emergent PCI is focused on "time is the cardiac muscle, time is life." Intervention physicians have endeavored to shorten the time between puncture and IRA reperfusion (needle-to-balloon time) (Tzifos et al., 2000). In this case report, two patients with AMI were successfully treated at our emergency department. We used transradial artery 5F Outlook TIG multifunctional angiography catheters (Terumo Corporation, Japan) for percutaneous transluminal coronary angioplasty (PTCA) and IRA pre-recanalization. This approach greatly shortened the needle-to-balloon time.

2. Disease History Data

2.1 Ethics statement

This study was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committee of the Second Clinical Medical School of Henan University of TCM. Written informed consent was obtained from the participants.

2.2 Case 1

A 75-year-old female patient was immediately hospitalized after 20 min of continuous retrosternal crush-like pain accompanied by profuse sweating at 02:50 on April 1, 2012. The patient was sad and felt tired a few days before this attack. She also suffered from a sudden retrosternal crush-like pain accompanied by profuse sweating 20 min before the same attack occurred. She took Suxiao Iiuxin pills orally but was not relieved. She was then rushed to the Second Clinical Medical School of Henan University of Chinese Medicine via 120 (an emergency call) and vomited once on the way. She also suffered from peptic ulcer and massive hemorrhage of the upper alimentary tract 10 years ago. Furthermore, she has suffered from hypertensive disease for 10 years and took enalapril meleate irregularly. She has also suffered from labored dyspnea for 5 years. She had no history of diabetes. She neither smoked nor consumed alcohol. Body examination showed a body temperature (T) of

36.2 ℃, a pulse rate (P) of 50/min, a heart rate (R) of 22/min, and a blood pressure (BP) of 140/90 mmHg. She was conscious but in a bad mood. She manifested cyanotic lips, profuse sweating, no jugular venous distension, extensive moist rales and wheezing sounds in both lungs, a heart rate of 50/min with normal heart rhythms, low and blunt heart sounds without noise, soft abdomen without hepatosplenomegaly, and no edema in both lower extremities. Her neurogenic examination results were normal. Electrocardiography (ECG) showed sinus bradycardia, bow back-like ST-segment elevations in leads II, III, and aVF by approximately l mV to 3 mV. Complete right bundle branch block was also revealed. Emergent myocardial enzyme electrolyte examination showed normal results; cTnI concentration was 0.11 ng/ml. Blood routine examination showed a WBC count of 6.67 × 10^9/L and an N level of 74.3%. Preliminary diagnosis was recorded as follows: coronary artery disease and acute inferior myocardial infarction with Kilip grade 3 and very high-risk hypertensive disease (grade 3). Routine analgesia, sedation, oxygen inhalation, and ECG monitoring were performed after the patient was hospitalized. Nitroglycerin was administered by intravenous dripping. Loading doses of clopidogrel and aspirin were administered orally. Emergency coronary angiography and a right radial artery approach were also performed. Local anesthesia of 2% lidocaine was administered. A 6F radial artery sheath was inserted after a puncture was successfully established. An intrathecal bolus injection of 200 μg of nitroglycerin and 300 U of heparin was administered. Furthermore, the right coronary artery (RCA) was infarcted; for this reason, a 5F Outlook TIG multifunctional angiography catheter (Terumo Corporation, Japan) was smoothly inserted into the opening of the IRA with the aid of a J-shaped wire in a left-anterior oblique position. Angiography showed complete occlusion at the proximal segment (Figure 1A). During this procedure, persistent chest pain and dysphoria were observed. To recanalize the RCA as early as possible, we directly introduced a BMW guidewire (Abbott Cardiovascular Systems Inc., USA) to the RCA through a 5F TIG catheter. The guidewire was difficult to insert, but it smoothly passed through the infarcted segment to the distal end of the RCA with a slightly greater strength. A 2.5 mm × 15 mm Maverick balloon (Boston Scientific Corporation, USA) was dilated at the RCA lesion site until the pressure reached 8 atm. Repeated angiography showed revascularization, local stenosis of 95% at the proximal and middle segments of the RCA, and forward TIMI blood flow grade 3 (Figure 1B). The time needed for the catheter to reach the balloon from the needle was 7 min.

Figure 1: 5F Outlook TIG coronary artery angiography shows complete occlusion of the right coronary artery (A). A BMW guide wire is sent along the 5F Outlook TIG angiography catheter, and the wire successfully passes through the occluded site and reaches the distal end of the right coronary artery; repeated angiography shows the recanalization of the right coronary artery (B).

After the treatment, the patient was greatly relieved from chest pain, and blood monitoring showed good results. ECG monitoring showed that the ST segment declined with transient bradycardia and ventricular premature beat. These manifestations spontaneously remitted 3 min later without any special treatment. The BMW guidewire was then withdrawn. The TIG angiography catheter was rotated to the left coronary artery opening; angiography showed normal running and distribution of the RCA without noticeable stenosis (Figure 2).

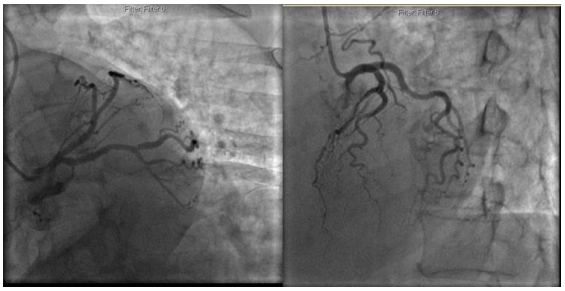

Figure 2: Left coronary angiography is accomplished, and noticeable stenoses in different body positions are not observed (A and B).

The TIG catheter was withdrawn and 4000 U of heparin was supplemented along the artery sheath. A J-shaped guidewire was used to direct a 6F JR4.0 guiding catheter (Cordis Corporation, USA) to the RCA opening. Angiography obtained the same results. A BMW guidewire was smoothly brought to the distal end of the RCA. The artery was predilated by inflating a 2.5 mm × 15 mm balloon to a pressure of 12 atm (Figure 3A). A 3.5 mm × 24 mm Sirolimus-eluting stent (Dunlop Medical Equipment Co., Ltd., Beijing) was placed inside. A pressure of 12 atm was released and the balloon was slightly withdrawn to expand at 16 atm (Figure 3B).

Figure 3: The guiding catheter is changed and stent insertion is accomplished (A and B).

Angiography showed satisfactory stent inflation without dissection and residual stenonsis, but a slow forward blood flow of TIMI grade 2 was observed (Figure 4A). Tirofiban (20 ml) and nitroglycerin (200 μg) were injected into the artery. After 3 min, angiography revealed a forward blood flow of TIMI grade 3 (Figure 4B). The operation was ended and the patient was safely returned to the ward.

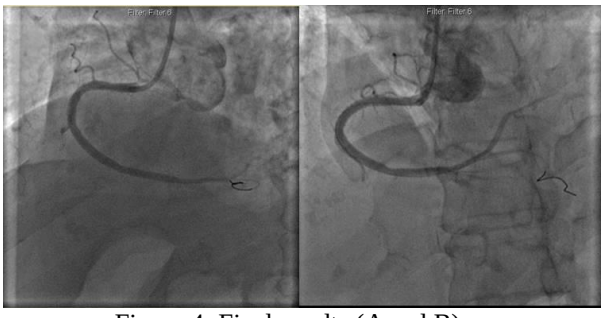

Figure 4: Final results (A and B).

2.3 Case 2

A 42-year-old male patient was immediately hospitalized after 2 h of continuous chest oppression and pain accompanied by profuse sweating at 20:00 on October 16, 2012. The patient had no history of hypertension and diabetes but smoked an average of 20 cigarettes per day. Body examination showed the following: T = 36.5 ℃; P = 70/min; R = 20/min; and BP = 157/116 mmHg. He was conscious but in a bad mood. He manifested neither noticeable cyanotic lips nor jugular venous distension but demonstrated respiratory harshness without moist rales in both lungs. He exhibited a heart rate of 50/min with normal heart rhythms, low and blunt heart sounds without noise, soft abdomen without hepatosplenomegaly, and no edema in lower extremities. His neurogenic examination results were normal. ECG showed sinus bradycardia with bow back-like ST-segment elevations in leads V1 to V5 by approximately l mV to 3 mV. He was preliminary diagnosed with acute extensive anterior myocardial infarction. After hospitalization, emergency coronary angiography was performed. A 5F Outlook TIG catheter was smoothly inserted in the opening of the left coronary artery in a head-straight position. Angiography showed that the initial site of the left anterior descending coronary artery (LAD) was completely occluded (Figure 5A). Tirofiban (20 ml; WuHan Grand Pharmaceutical Group Co., Ltd., China) was injected into the intracoronary artery. A Runthrough guidewire was successfully brought to the distal end of the LAD via the TIG catheter. A 2.5 mm × 15 mm Maverick balloon was used to dilate the occluded site at a pressure of 8 atm. Repeated angiography showed revascularization, 90% local stenosis at the proximal segment of the LAD, and a forward TIMI blood flow of grade 3 (Figures 5B and 6A).

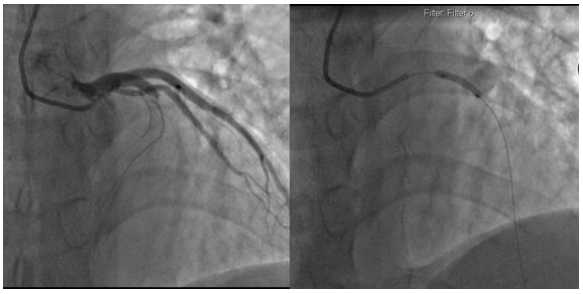

Figure 5: 5F Outlook TIG coronary artery angiography shows complete occlusion of the anterior descending branch (A). A BMW guide wire is sent along the 5F Outlook TIG angiography catheter, and the wire successfully passes through the occluded site and reaches the distal end of the right coronary artery; a 2.5 mm × 15 mm Maverick balloon is sent to the occluded site along the guide wire and the dilation pressure is 8 atm (B).

The patient did not complain of indisposition; blood pressure monitoring showed good results and ECG monitoring did not show noticeable reperfusion arrhythmia. The Runthrough guidewire was then withdrawn. The TIG catheter was rotated through the opening of the RCA. Angiography showed normal running and distribution of the RCA without noticeable stenosis (Figure 6B). The TIG catheter was also withdrawn. Heparin (4000 U) was supplemented. A 6F XB 3.5 guiding catheter (Cordis Corporation, USA) was placed at the opening of the left coronary artery. The Runthrough guidewire was successfully brought to the distal end of the LAD. A 4.0 mm × 18 mm Dunlop stent was placed inside and a pressure of 12 atm was released. The balloon was slightly withdrawn and then inflated at 16 atm. Angiography showed satisfactory stent inflation without dissection and residual stenosis. A forward blood flow of TIMI grade 3 was also observed (Figure 7). The operation was finished and the patient was safely returned to the ward.

Figure 6: Repeated angiography shows anterior descending branch recanalization (A). Right coronary artery angiography shows no noticeable stenosis (B).

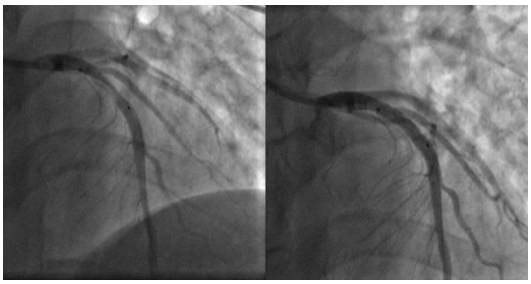

Figure 7: The guiding catheter is replaced and stent insertion is successfully performed (A and B).

3. Discussion

Sufficient recanalization of IRA as early as possible is an important procedure to treat AMI and thus restore forward blood flow. With this procedure, the agonal myocardium is saved, the infarcted area is diminished, the fatality rate is reduced, and prognosis is improved. Direct PCT has become the preferred treatment for AMI (Xu et al., 2009). Traditional methods used to treat AMI have mostly adopted a transfemoral artery approach. In the present study, 6F Judkins L4.0 and Judkins R4.0 coronary angiography catheters were successively inserted into the left and right coronary arteries via their openings. The catheters were subsequently replaced with the same type of catheters and a guidewire was brought to the distal end of the IRA. After the balloon was dilated, a stent was placed inside to complete the operation. During the procedure, the catheters were replaced at least twice. The time of inserting the catheter from the needle to the balloon should be prolonged when the peripheral blood vessels become buckled or the type of catheter used is unsuitable. Such factors contradict with one of the basic requirements for AMI: to recanalize the occluded vessel as early as possible to save the myocardium.

As interventional instruments are continuously developed and surgeon's experiences become accumulated, the number of physicians who use the transradial artery approach in intervention therapy of AMI has increased. Such physicians also use common types of catheters for left and right coronary artery angiography.

A "guiding catheter" refers to a channel through which interventional instruments, such as sacculi and stents, are conveyed. Excellent coaxiality and support as well as a sufficiently large internal diameter are the premises of successful PCI. The structures of an angiography catheter and a guiding catheter are almost similar; however, an angiography catheter has weaker support, poorer visibility, anti-fold capability, smaller lumen, and a larger endocardial surface friction. These factors are merely applicable for coronary arteriography.

5F Outlook TIG multifunctional angiography catheters are one of the most extensively used angiography catheters in China. TIG catheters comprise a soft head with good flexibility. A lateral aperture is found 3 mm away from the headend with an outer diameter of 0.067 inch (1.70 mm) and an inner diameter of 0.047 inch (3.5 F). This aperture sufficiently accommodates a Maverick balloon with an outer diameter of 2.4 F to 2.6 F. This feature of the catheter decreases the risk of angiospasm during catheter replacement and reduces operating time. This catheter is particularly suitable for comparatively young patients whose coronary artery disorders are of the single-vessel type and primarily manifested by acute thrombotic occlusion. For these patients, the support capacity of the guiding catheter is necessary but at a lesser extent and the catheter can pass through the occluded site more easily (Chen et al., 2010). Considering the advancements in transradial artery coronary arteriography and PCI as well as proficient use of a 5F Outlook TIG multifunctional angiography catheter, we could perform pre-PTCA successfully in technical and clinical practice during emergency situations by using angiography catheters. This approach also shortens the recanalization time of IRA, which is of great significance for patients with unstable hemodynamics.

In this study, a transradial artery approach was used instead of conventional methods to treat the two patients to allow the angiography catheter to reach the RCA opening directly. We successfully and timely accomplished emergency PTCA; as a result, the IRA was recanalized as early as possible. The time for the catheter to reach the balloon from the needle was also shortened, thereby timely reperfusing the ischemic and agonal myocardia. Furthermore, patients' benefits were maximized.

However, 5F angiography catheters have unsatisfactory support and anti-fold capacity because of the structures and properties of their guiding catheters. These guiding catheters are easily exposed to deformities and collapse and their friction force on the luminal membrane surface is large; therefore, the

catheter, the balloon, and the guidewire are likely to slip out of the coronary artery. The operation should be performed rapidly, but overexertion should be avoided. After PTCA is successfully performed, myocardial blood flow is restored. The proposed procedure can be performed slowly; conventional elective PCI is safer and more reliable. Therefore, guiding catheters should be changed in the same condition. For patients with blood vessel circuit, open abnormalities, or severe calcification, the approach adopted in this study is recommended.

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