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CASE REPORT / ПРИКАЗ БОЛЕСНИКА

Recanalization of coronary artery chronic total occlusion by retrograde approach

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SUMMARY

Introduction Chronic total occlusion (CTO) is defined as a 100% obstruction of the blood vessel lumen with Thrombolysis in Myocardial Infarction grade 0 flow in the occluded segment at least three months old. Advancement of technological devices and techniques used during the percutaneous coronary interventions (PCI) in the past years brought more success in blood vessel recanalization. According to the latest guidelines for myocardial revascularization, the CTO treatment should be considered when there are symptoms or objective proof of viability or ischemia in the occluded area.

The aim of this work is to present two cases with a recanalization of the coronary artery CTO by the retrograde approach.

Outline of cases The first patient had a single vessel coronary disease which led to a decision to first attempt PCI. During the attempt of antegrade recanalization, the guidewire penetrated subintimally, risking blood vessel dissection below the occluded area as well as serious complications. Retrograde approach enabled easier and safer passing of guidewire through the occlusion and then successful establishment of the antegrade flow. In the second case, the antegrade approach was also first attempted. Since it could not pass through the occluded area despite changing several guidewires, the strategy was changed during the intervention. It was continued with the retrograde approach, which led to the successful revascularization.

Conclusion These two cases demonstrate that retrograde approach and new technological improvements in dedicated guidewires can be implemented in everyday angiography practice for successful recanalization of CTO lesions.

Keywords: coronary artery occlusion; chronic total occlusion; percutaneous coronary interventions; retrograde approach

INTRODUCTION

Chronic total occlusion (CTO) is defined as a 100% obstruction of the blood vessel lumen with Thrombolysis in Myocardial Infarction (TIMI) grade 0 flow in the occluded segment which is at least three months old, it is assumed that CTO with good collaterals is the same as a 90% narrowing of a coronary blood vessel [1]. By a functional examination of collateral circulation, Werner et al. [2] proved that angiographically well-developed collaterals cannot provide enough blood supply to the occluded segment. Even in patients with well-preserved ventricular function, collaterals provide good "flow reserve" in less than 10% of the cases [2]. Hence, the symptoms of stable angina pectoris can be manifested since, under stress, there is inadequate perfusion in some segment of the myocardium through collateral circulation. However, it needs to be stated that the risk of developing some form of acute coronary syndrome as a consequence of CTO is rare [3].

Recanalization of CTO represents one of the biggest challenges in interventional cardiology. The advancement of technological devices and techniques used during percutaneous coronary intervention (PCI) in the past years brought more success in blood vessel recanalization [4]. According to the latest guidelines for the myocardial revascularization, the CTO treatment should be considered when there are symptoms or objective proof of viability or ischemia in the area of occluded artery [5]. Not only that the successful revascularization of CTO contributes to the improvement of functionality and relief of anginal discomforts, but it also leads to the better left ventricular systolic ejection function and has positive correlation in relation to the long-term survival [6–9].

The success of the CTO revascularization is smaller than in other lesions and it largely depends on operators' experience, good analysis of the lesion itself, and available technical devices. Until 2005, the success of CTO revascularization had remained unchanged for a long period of time and was around 60–70%. Since the CTO revascularization was significantly less successful, the representation of these procedures was therefore small and did not exceed 10%, so the patients were more frequently referred to coronary artery bypass grafting (CABG) [10, 11].

Introducing modern techniques [controlled antegrade and retrograde subintimal tracking (CART), reverse CART, knuckle wire technique],

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modern retrograde approach to CTO revascularization gained in importance and started being used more frequently especially when antegrade approach failed. In more complex lesions, the operators from the beginning choose retrograde approach due to its better efficacy [12, 13].

Here, we present our initial experience in two cases of successful revascularization of CTO by the retrograde approach.

CASE REPORT

Case 1

A 61-year-old male patient was admitted to the Institute of Cardiovascular Diseases of Vojvodina in February 2015 for elective coronarography due to stable angina pectoris CCS 2 and previous anterior wall myocardial infarction from November 2013, when he underwent conservative treatment in the regional center. The stress test demonstrated signs of anterior wall ischemia. Echocardiography examination registered hypokinesis on medioapical and anteroseptal area and slightly decreased ejection fraction of 50%.

The patient underwent diagnostic coronarography, which found single-vessel coronary disease along with the chronic occlusion of the proximal left anterior descending (LAD) segment. Since it was an over 20 mm long lesion with calcifications, the J-CTO score was 2, i.e. a lesion difficult for revascularization. The case was presented at the Board of Cardiologists and Cardiac Surgeons, who suggested the attempt of CTO LAD opening.

The recanalization of CTO LAD with the antegrade approach was tried first. Judkins left 4 guiding catheter (Launcher, Medtronic, Minneapolis, MN, USA) was placed in the left main coronary artery (LMCA) and right amplatz 1 guiding catheter (Launcher, Medtronic) was placed in the right coronary artery (RCA). The catheter in the RCA was used to show the area below the occlusion through collateral circulation and for better orientation during the wire passing through the occlusion. Since the guidewires Fielder XT and Confianza (Asahi Intecc Co., Ltd., Nagoya-shi, Japan) could not be advanced and there was a great possibility of subintimal guidewire penetration and blood vessel dissection below the occluded area, we decided to try recanalization using the retrograde approach (Figure 1).

The guidewire Runthrough NS (Terumo Corporation, Tokyo, Japan) was placed through the donor RCA and was used for positioning of the Corsair microcatheter (Asahi Intecc Co., Ltd.) below the septal collaterals. Then the Sion guidewire (Asahi Intecc Co., Ltd.) was used for crossing through the septal collaterals and positioning the Corsair in the LAD below the occluded area. Arter passing through the occlusion site with the Sion guidewire, microcatheter Corasire was placed in the LMCA. Afterwards, the externalization of Asahi RG3 guidewire was performed through the catheter in the LMCA. Balloon dilatation of the occlusion was done using the externalized guidewire Asahi RG3, establishing antegrade flow.

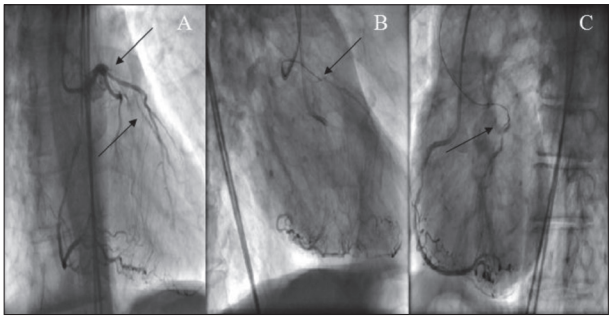

Figure 1. A) The upper arrow shows the occluded area, while the lower arrow shows distal part of the blood vessel being shown through the collateral circulation; arrows in images B and C show subintimal guidewire penetration though the occluded area

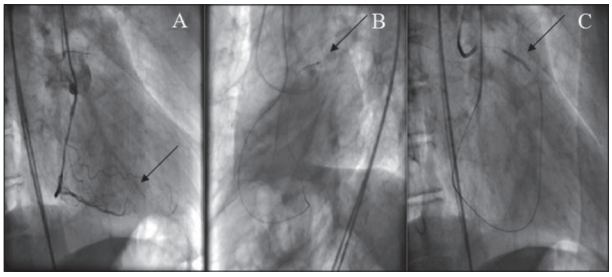

Figure 2. A) The arrow shows the guidewire in the Corsair at the septal collateral channels between the right coronary artery and the left anterior descending artery (LAD); B) the arrow showing the Corsair below the occlusion in the LAD; C) after the guidewire was passed through the occlusion, it was used to perform percutaneous transluminal coronary angioplasty of the occlusion in the LAD

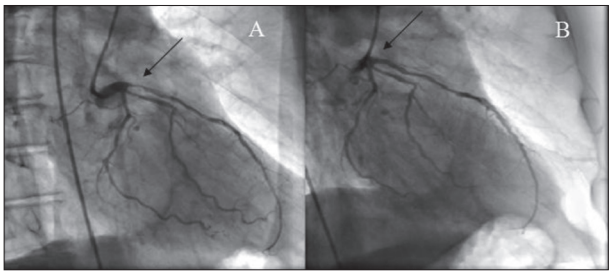

Figure 3. A) The result after percutaneous transluminal coronary angioplasty of the LAD and the establishment of the antegrade flow; B) the arrow indicates where the drug-eluting stent was implanted with the optimal result

A new Runthrough NS guidewire was placed in the LAD through the catheter and a drug-eluting stent Biomatrix Flex 18 × 2.75 mm (Biosensors International, Newport Beach, CA, USA) was implanted giving optimal result (Figures 2 and 3).

Case 2

A 56-year-old male patient was admitted to the Institute of Cardiovascular Diseases of Vojvodina in January 2015 for planned PCI of CTO on the LAD and the circumflex coronary artery (Cx). The patient was hospitalized at our hospital in December 2014 due to the inferior wall ST-elevation myocardial infarction (STEMI) when primary PCI was performed with an implantation of one stent in the RCA and one in the posterolateral branch. Since the Syntax score was 23.5, the Board of Cardiologists and Cardiac Surgeons decided that the PCI of CTO on the

LAD and significant Cx lesion should be attempted, and in case the CTO LAD recanalization was unsuccessful, the surgical myocardial revascularization should be done. The J-CTO score of the LAD lesion was 2 since it was over 20 mm long and had calcifications, or, in other words, it was a lesion difficult for revascularization.

The recanalization of CTO LAD using the antegrade approach was first attempted. Two guiding catheters were placed, one EBU 3.5 (Launcher, Medtronic) in the LMCA and left Amplatz 1 (Launcher, Medtronic) was placed in the RCA. Initially, it was planned for the catheter in the RCA to serve as a retrograde visualization aid of the artery below the LAD occlusion. Since none of the guidewires – Fielder XT and Gaia second (Asahi Intecc Co., Ltd.) – could pass the occlusion, we decided to switch to the retrograde approach (Figure 4).

The Runthrough NS guidewire (Terumo Corporation) was placed through the donor RCA and was used for the positioning of the Corsair microcatheter (Asahi Intecc Co., Ltd.) below the septal collaterals. The Sion guidewire (Asahi Intecc Co., Ltd.) passed through septal collaterals, distal occlusion cap, and then through the occlusion itself. The guidewire was then placed in the left guiding catheter in the LMCA. The advancement with the Corsair was continued, placing it also through the occlusion in the left guiding catheter in the LMCA. The Runthrough NS guidewire was placed in the Corsair microcatheter which was in the LMCA guiding catheter. The Corsair was then gradually removed and the Runthrough NS guidewire was released below the occluded LAD area (Figure 5). The intervention continued using the antegrade approach. After the predilatation, the antegrade flow was established and two drug-eluting stents, Promus Premier 32 × 2.5 mm (Boston Scientific, Marlborough, MA, USA) and Resolute 26 × 2.5 mm (Medtronic) were implanted showing optimal results (Figure 6).

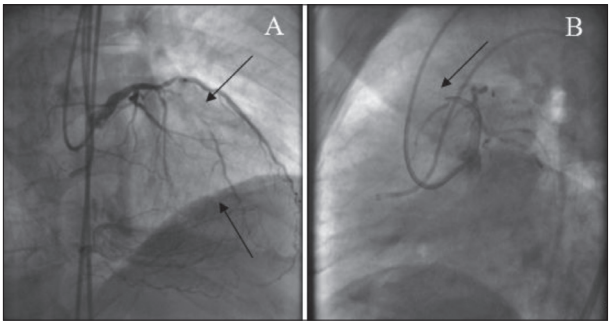

Figure 4. A) The upper arrow shows the area of occlusion in the LAD, the lower arrow points to the transseptal collaterals; B) the arrow points to the occluded area as well as the coronary guide that could not advance further in the occluded area

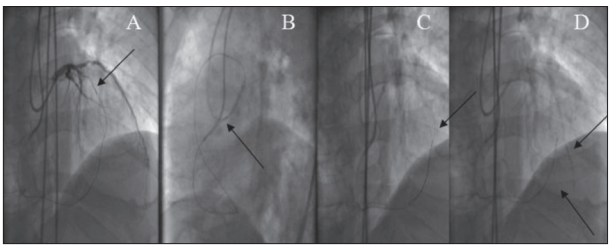

Figure 5. A) The guidewire in the occluded area is shown as well as the Corsair, which is below the occluded area; B) the Corsair placed in the catheter which is in the left coronary artery; C) the Corsair is returned to the septal collateral while the guidewire, placed antegradely in the Corsair, is being released; D) The guidewire is placed in the LAD and is used to continue the intervention while the Corsair is being removed

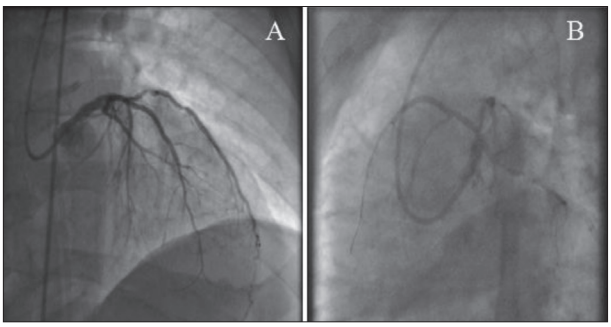

Figure 6. Both A) and B) show the optimal result after the implantation of two stents

DISCUSSION

CTO represents one of the biggest and most demanding challenges in the interventional cardiology. Registering CTO along with the lesions in other coronary blood vessels strongly influences the decision making for surgical myocardial revascularization (CABG).

The exact prevalence of chronic total occlusions in general population is still unknown. However, some studies have shown that CTO can be found in 24% of patients who underwent coronarography and that it is found in 52% of cases where patients have at least one lesion > 70% [14, 15]. To estimate the difficulty of guidewire crossing through CTO and to plan revascularization strategy, the J-CTO score is used. It is based on assigning one point for each of the five factors that influence the complexity of CTO revascularization (prior failed attempt to revascularize the CTO, blunt stump, calcification, lesion bending, and occlusion length). Based on the scoring system, the lesions are classified as easy (J-CTO 0), intermediate (J-CTO 1), difficult (J-CTO 2), and very difficult (J-CTO 3) [16].

Introduction of modern techniques in CTO recanalization by Japanese experts, primarily retrograde approach, contributed to the more frequent use of CTO revascularization by percutaneous coronary intervention [17].

The use of intravascular diagnostic procedures, particularly intravascular ultrasound (IVUS), significantly increased the sureness of performing PCI CTO. Unlike optical coherence tomography, which can only be used after the establishment of the antegrade flow, IVUS needs no contrast during scanning and enables guidewire position checking during the occlusion crossing.

Pathohistology has demonstrated that CTO segments are thinner and softer in the distal than in the proximal cap. Therefore, the distal cap is more suitable for guidewire penetration in relation to the proximal cap, and this is the mechanism underlying the advantage [18].

Due to the complexity of PCI of CTO lesions, the risk of complications is slightly bigger than during PCI of other

lesions. Therefore, it is more common for complications to occur, such as blood vessel perforation, periprocedural myocardial infarction, and stent slipping. Radiation injuries and contrast-induced nephropathy are also possible due to the length and complexity of the procedure [19, 20].

UK National Institute for Cardiovascular Outcomes Research analyzed the data from 13,500 patients who underwent elective PCI of one or more CTO lesions in the period from 2005 to 2009. The results showed that the successful PCI is strongly related to the reduction of all causes of mortality [21].

In time, the success of CTO revascularization significantly increased from previous 50–60% up to 90% primarily due to experienced operators as well as the use of modern techniques and the growing use of the retrograde approach [12].

It should be pointed out that there is still insufficient amount of randomized clinical trials that demonstrate the advantages of different approaches to CTO revascularization as well as their long-term patient benefit.

We have presented two cases of an unsuccessful antegrade approach to CTO revascularization where both interventions were immediately continued with a successful retrograde approach.

The first patient had a single-vessel coronary disease, J-CTO score 2 (difficult). For that reason it was decided to first attempt PCI, and then, if it failed, to undertake CABG. During the attempt of the antegrade recanalization, the guidewire was penetrating subintimally with the risk of blood vessel dissection below the occluded area and the risk of serious complications. The use of the retrograde approach enabled easier and safer passing of the guidewire through the occlusion as well as the successful establishment of the antegrade flow. Then, the antegrade guidewire was placed and used for the stent implantation. It should be noted that, in these types of cases, the use of dual lumen catheter for antegrade guidewire placement is highly recommended because it significantly lowers the risk of blood vessel dissection. In this case, due to the lack of dual lumen catheter, it was not used.

The second case showed a patient who initially had a three-vessel coronary disease which was, since he had had STEMI, first treated with the PCI. In this case, the J-CTO score was also 2 (difficult). Afterwards, the coronary disease could be completely solved with the percutaneous coronary intervention or the hybrid procedure, i.e. surgical revascularization of the LMCA system. It was also initially tried with the antegrade approach but, in spite of changing several guidewires, we were not able to pass through the occluded area. The strategy was changed during the intervention and was continued with the retrograde approach. Since the distal cap was softer, the guidewire followed by the microcatheter went through the occluded area, enabling the intervention to continue and finish with the Randezvous technique, establishing the antegrade flow [22].

Pure retrograde technique was used in both cases. It should be stated that there are numerous other techniques that increase the technical success rate of CTO revascularization by 20%. Successful treatment of lesions in both patients permitted further continuation of the medical treatment.

These two cases demonstrate that the retrograde approach and new technological improvements in dedicated guidewires can be implemented in everyday angiography practice for successful recanalization of CTO lesions. Therefore, we expect that this approach will be used more frequently in our center to improve the clinical outcome of these patients.

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Реканализација хроничне тоталне оклузије коронарне артерије ретроградним приступом

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САЖЕТАК

Увод Хронична тотална оклузија (ХТО) дефинише се као 100% опструкција лумена крвног суда са *TIMI* 0 протоком у том сегменту, у периоду од најмање три месеца. Напредак технолошких средстава и техника које се користе током перкутане коронарне интервенције (ПКИ) довео је до веће успешности у реканализацији крвног суда. Према званичном водичу за реваскуларизацију миокарда, решавање ХТО треба размотрити у случају присуства симптома или објективних доказа вијабилности и исхемије у подручју оклудиране артерије.

Циљ овог рада је приказ два болесника са реканализацијом коронарних артерија код ХТО ретроградним приступом.

Приказ болесника Код првог болесника се радило о једноудовној коронарној болести, и то је био разлог да се прво одлучи за покушај ПКИ. Приликом покушаја антероградне реканализације жичани водич је продирао субинтимално уз ризик настанка дисекције крвног суда испод подручја оклузије; самим тим постојао је висок ризик за настанак озбиљних компликација. Примена ретроградног приступа је омогућила лакши и безбеднији пролазак жичаног водича кроз оклузију и успешно успостављање антероградног протока. И у другом случају иницијално је покушано са антероградним приступом, али се није могло проћи кроз подручје оклузије. Настављено је ретроградним приступом, што је резултирало успешном реваскуларизацијом.

Закључак Ретроградни приступ заједно са новим технолошким достигнућима и специјализованим жичаним водичима може се увести у свакодневну праксу ради успешне реваскуларизације ХТО.

Кључне речи: оклузија коронарних артерија, хронична тотална оклузија; перкутане коронарне интервенције, ретроградни приступ