Advances in Cardiac Research

REVİEW

Rota-Cut Technique: A Simple Technique for Calcified Coronary Lesion

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Abstract

Background: Performing successful percutaneous coronary interventions (PCI) is extremely difficult when dealing with severely calcified coronary lesions. Among the alternatives for treating calcified lesions is the Rota-Cut technique. This technique combines using a rotablator and cutting balloon as one treatment.

Discussion: Coronary calcification may interfere with the placement of stents, leading to inadequate expansion and positioning, as well as causing direct harm to the stents. Performing PCI on calcified coronary artery disease (CAD) is linked to lower procedural success rates and increased risk of early and late complications. An ideal plaque modification equipment should be user-friendly, safe, efficient, and provide positive short- and long-term results. We can now safely and easily treat calcified lesions thanks to the development of the Rotablator and the cutting balloon, also known as the Rota-Cut technique. When combined, rotational atherectomy made a tunnel through calcium plaque which the cutting balloon can pass to complete the plaque modification after it has been inserted. Rota-Cut technique is a safe and efficient approach for calcified lesions.

Conclusion: The operator's skill in choosing a calcium-modification approach to reduce complexity before stent implantation is essential for diagnosing these lesions. Rotational atherectomy made a tunnel through calcium plaque that the cutting balloon can pass through to finish the plaque modification once it is in place.

Keywords: Calcified coronary lesion, Cutting baloon, Rota-Cut concept, Rotational atherectomy.

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Introduction

Performing successful percutaneous coronary interventions (PCI) is extremely difficult when dealing with severely calcified coronary lesions[1] . Coronary calcification is linked to age, comorbid disease such as renal disease, diabetes mellitus, also smoking habit[2]. Using intravascular imaging methods like optical coherence tomography (OCT) and intravascular ultrasound (IVUS) is essential for precisely assessing plaque severity and composition, as coronary calcium may not be accurately evaluated in coronary angiography and fluoroscopy[3].

The drug coating on drug-eluting stents (DES) may be damaged by the forceful insertion of stents into heavily calcified lesions. Furthermore, the efficiency of the DES could be restricted by inadequate drug diffusion through extensive calcium deposits to the subintimal layer. Calcifications even in the modern era, patients with DES who have moderate to severe lesion calcification are more likely to experience major adverse cardiovascular events andtarget lesion revascularization during follow-up[4].

When this type of calcified lesion is identified, suitable ablative procedures can modify lesions and prepare vessels before DES implantation. Numerous instruments and methods have been put forth to address problems associated with calcified lesions, and several of them have demonstrated noteworthy safety and efficacy evidence[5]. Among the alternatives for treating calcified lesions is the Rota-Cut technique. This technique combines using a rotablator and cutting balloon as one treatment. This review will briefly discuss the Rota-Cut technique.

Discussion

Calcified Coronary Lesion

Calcified coronary lesions (CCLs) occur in as much as one-third of patients having percutaneous coronary intervention (PCI). CCLs represent as a big problem in the cardiac catheterization laboratory[6]. Given the aging of the population and the prevalence of concomitant conditions like diabetes and chronic kidney disease, this high prevalence is even rising. The success rate of PCI is decreased by calcified coronary lesions, which also raise the risk of stent malapposition and under-expansion. These conditions increase the risk of intrastent restenosis (ISR) and thrombosis, as well as an increase in procedural complications like edge dissection and coronary ruptures[7].

In addition, it is well established that the degree of coronary artery calcification, even in asymptomatic patients, increases the risk of future significant adverse cardiac events and has a close correlation with atherosclerosis[8]. The frequency of coronary artery calcification varies according to the population under investigation and the diagnosis mode[3]. Radiopacities seen during cardiac motion suggest mild calcification, but radiopacities seen on both sides of lumen withouth cardiac motion indicate severe calcification according to the standard angiographic criteria. Approximately 18% to 60% of individuals exhibit moderate to severe calcification[9,10].

Percutaneous coronary interventions (PCI) are complicated by calcification for several reasons. First, resistance to the advancement of various devices, particularly when tortuosity is present (which eventually results in "non-crossable" lesions). Second, decreased plaque flexibility leads to the need for increased pressure in dilatation balloons or devices that affect plaque (which eventually results in "non-dilatable" lesions). Lastly, challenges in expanding and advancing the stent[11]. The non-homogeneous release of antiproliferative medicines can result from additional problems such as malapposition and polymer destruction[12]. Calcification is a significant predictor of the SYNTAX score and is related with poor outcomes including higher rates of adverse events and mortality following percutaneous coronary intervention[13].

The parameters for calcium alteration are determined by the length, arc, and thickness of the calcium based on the available evidence. It is recommended to make modifications to arcs of 360° or 270° with a calcified length of ≥5.0 mm before deploying the stent[14]. Considering calcium modification for lesions with a minimum calcium thickness of ≥0.5 mm as determined by OCT, tiny or negatively modified vasculature, and calcified nodule inside the target segment. When selecting the appropriate method for calcium modification, consider the size of the calcified portion. Long, diffusely calcified lesions may benefit most from atherectomy, whereas localized lesions might respond well to specialized balloon therapy. Conduct a 1:1 cutting balloon angioplasty to completely expand the lumen in a minimum of two perspectives or conduct further imaging to inspect the lesion. Proceed with the stent deployment if these requirements are satisfied. Prior to stent placement, consider utilizing intravascular imaging to guide calcium modification treatments if the initial approach failed to achieve the desired results[15,16].

Rota-Cut Concept

Rotational atherectomy weakens the outermost layers of calcium but not the deeper ones and it occasionally is insufficient to prepare plaque adequately. However, cutting balloon can enhance the plaque modification that rotational atherectomy offers[17]. Rotational atherectomy, when combined with a cutting balloon, affects the surface calcium by creating a tunnel for the balloon to navigate through and complete the plaque modification process at the designated location. One distinction between the two methods is that, in the absence of severe calcification, cutting balloon can aid in the breakdown of the calcium layer[18]. Rota-Cut concept is explained in Figure 1.

Rotational Atherectomy

Rotational atherectomy disrupts calcium by creating fissures or cracks within it, as evidenced by studies using intracoronary imaging. This approach is suggested for treating non-crossable stenoses or superficial luminal calcium identified through imaging analysis[19]. The described differential cutting technique using rotating atherectomy aims to enable the removal of hard plaques while protecting elastic tissue that moves away from the cutting tool[20]. The differential cutting, which is accomplished through rotating atherectomy, is intended to protect nearby elastic tissue that moves away from the ablating burr while permitting the mechanical ablation of hard fibrocalcific plaques. The Rotablator System (Boston Scientific) comprises an elliptical burr covered with diamond-sized crystals and nickel-plated. The device comprises a single advancer for transferring rotational speed to the burr, a gas-driven turbine, a control panel, a foot pedal, and an activator in the connecting handle[21]. The ROTAPro features a better user interface with coordinated controls in the advancement device, facilitating operation for a single operator. The burr advancement control now has a button on top of it, replacing the pedal. To switch on the Dynaglide mode, there is an additional button on the back of the gadget. The console requires less time to configure, has a digital screen, and is smaller.

To minimize procedural problems, the most recent indications for using a Rotablator suggest using standardized protocols and lower burr sizes (i.e.,

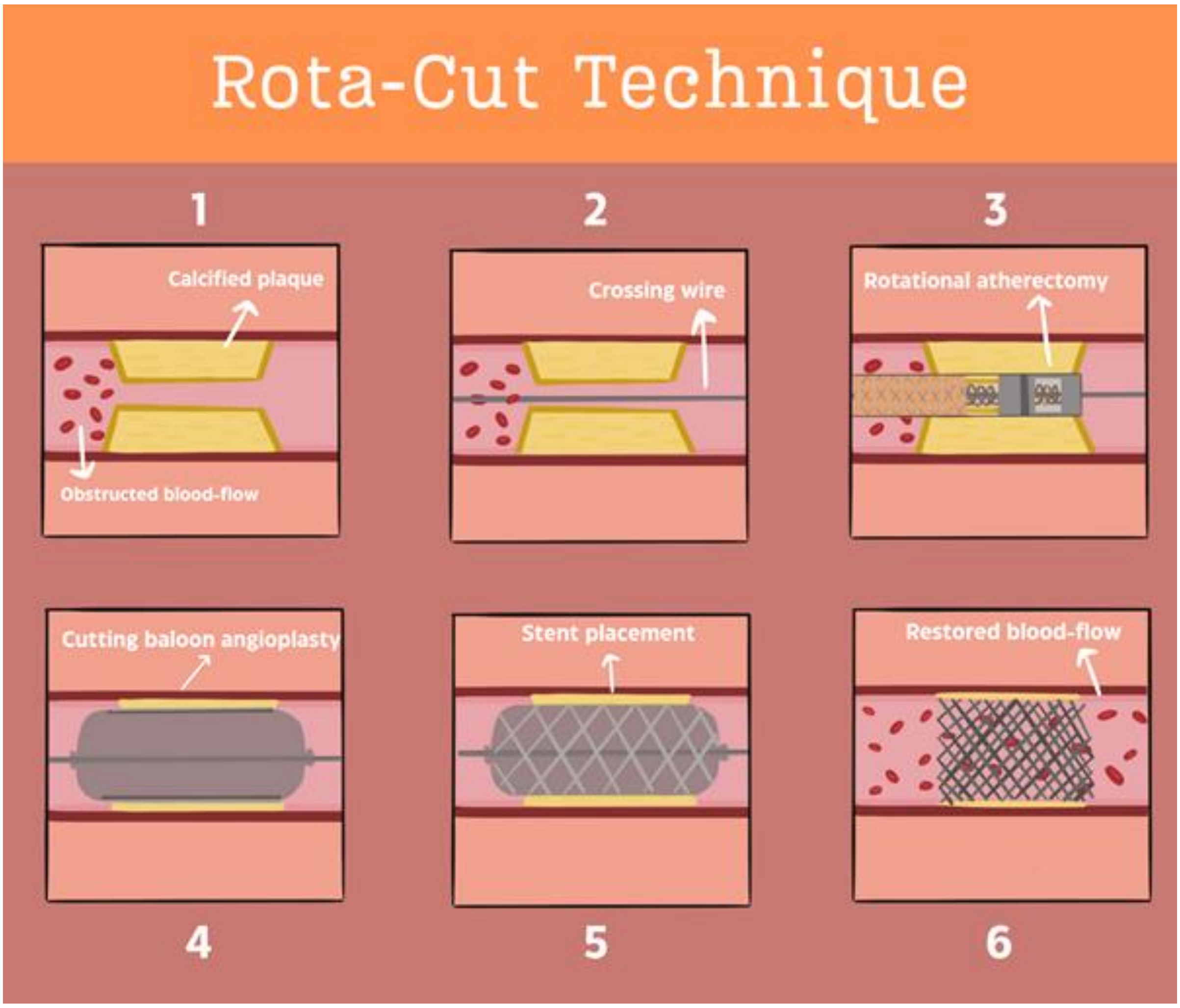

Fig 1. Rota-Cut Technique

rotating at rates between 135,000 and 180,000 rpm). In heavily calcified vessels, even using specialized 330-mm long wires may not always be optimal. Hence, they are usually inserted via an over-the-wire balloon or microcatheter following the placement of a standard coronary wire[22]. Typically, short burr runs are selected. To prevent decrease in rotational speed below 5000 rpm that can lead to severe issues, it is important to monitor fluoroscopic, auditory, and tactile indications. This is facilitated by the "pecking motion" approach, where the burr is moved back and forth to reduce the ablation time. The prevalence of rotational atherectomy in European countries remains low, ranging from 0.8% to 3.1%, despite being considered an effective technique for reducing calcified lesions during PCI[22].

The main reason for using rotational atherectomy in treating calcified coronary lesions that cannot be dilated with standard methods is to adjust the plaque to allow proper stent expansion and apposition[23]. The following variables greatly affect the results of rotational atherectomy: burr size, luminal area, and calcium eccentricity. A concentric lesion with a limited lumen area smaller than the burr size and circumferential distribution of calcium is the ideal situation to produce adequate luminal gain[24].

Cutting Balloon

The Cutting Balloon is a revolutionary tool utilized in percutaneous coronary treatments for angioplasty. It can minimize vascular stress and injury by cutting the vessel longitudinally instead of causing uncontrolled rupture of the atherosclerotic plaque. Atherotomes establish a precise fault line to guarantee the fracture propagates in an ordered manner during dilatation. Lower balloon inflation pressures are recommended while using the Cutting Balloon. It can reduce the risk of in-stent restenosis and neoproliferative response by dilating the target arterial more efficiently[25]. Cutting balloons is advantageous for addressing common fibrous plaques in restenotic stents caused by neointimal hyperplasia. Cutting balloons are characterized by three or four metal microblades arranged lengthwise on the balloon's surface. These blades make radial incisions in the media when the balloon is inflated. This hinders the expansion of neointima by reducing elastic recoil. Operator should be cautious while considering re-crossing a cutting balloon through the struts of a metallic stent to prevent possible entanglement. Cutting balloon angioplasty shows a higher risk of perforation compared to plain-only balloon angioplasty (POBA), but no difference in six-month binary restenosis[26].

The Wolverine balloon, manufactured by Boston Scientific, is a one example of advanced device in cutting balloon technology in recent years. This cutting balloon and catheter have been updated to include a more deliverable catheter suitable for a 5F guiding system with enhanced distal tip flexibility (203.4 against 269.8 g/cm). Bench testing indicates a smaller lesion entry profile of 0.017″ compared to 0.021″ and a mid-balloon profile of 0.036″ compared to 0.042″[27]. A cutting balloon is used as an alternative to balloon angioplasty to minimize vessel damage and expansion by employing precise cutting with sharp metal blades, mostly cutting through the plaque instead of compressing it aggressively. In comparison to balloon angioplasty, the cutting balloon's acute lumen gain mechanism is typified by a greater reduction in plaque and a tendency toward less vascular expansion[28]. The acute lumen gain that the cutting balloon was able to achieve in calcified lesions was substantially greater, and its mechanisms resembled those of the balloon angioplasty. This could be related to the gaps that the controlled cutting created[29].

Rota-Cut Technique Protocol

Handling complex calcified coronary lesions usually involves thorough preparation and anticipating potential future complications. When choosing a guiding catheter and vascular access, several factors must be considered. These include the system's stability during the process, the operator's familiarity with radial and femoral access, adequate internal diameter for the chosen burr size, and the possibility of bleeding and vascular problems. Standard 6 Fr guiding catheters are generally safe for the majority of surgical procedures. A 7 Fr guiding catheter is advised for burr sizes up to 1.75 mm, while an 8 Fr guiding catheter must be taken into consideration for burrs larger than 2 mm. The inner diameter of guiding catheters can differ somewhat between manufacturers, and certain 6 Fr catheters can eventually be used to conduct RA with a 1.75 mm burr[30].

During rotating atherectomy, a various burr size, usually using 1.25, 1.50, or 1.75 mm was utilized with the aim of reaching a burr/vessel ratio of 0.5 (up to 0.7 if necessary). The burr rotated at a rate between 140,000 and 180,000 revolutions per minute. As soon as possible, the burr was positioned close to the lesion to prevent damage to the intact section of the vessel. Nitroglycerin and intracoronary heparin were utilized to avoid any slow flow during or following rotational atherectomy. Proceed with the balloon cutting after the rotational atherectomy has been completed[31]. The cutting balloon used for pre-dilatation had a diameter that was less than or equal to 0.5 mm of the desired stent size, as determined by IVUS measurements of vascular media-to-media diameters. Following confirmation of the balloon's full expansion, stents were inserted. When IVUS showed inadequate stent expansion following stenting, non-compliant balloon post dilatation was taken into consideration. The reference vessel diameter was used to determine the final balloon size in a 1:1 ratio[32].

Conclusion

PCI for calcified CAD is becoming more frequent and is linked to increased procedural risk as well as a higher chance of both short- and long-term adverse effects. The ability of the operator to select various technique that might lessen this complexity before stent insertion makes the diagnosis of these lesions crucial. There are numerous ways to treat these lesions, such as atherectomy and cutting balloons or the Rota-Cut technique. Rotational atherectomy made a tunnel through calcium plaque that the cutting balloon can pass through to finish the plaque modification once it is in place.

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Conflict of interest

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