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Drug-Coated Balloon: Perspective of Current Evidence

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Abstract

Context: The drug-coated balloons (DCB) are angioplasty balloons that have a coating of an anti-proliferative drug which is delivered to the vessel wall when the balloon is inflated at specific low pressures for a set amount of time and a relatively new Percutaneous Coronary Intervention (PCI) technique in the "stentless" coronary approach. This review summarizes current evidence on DCBs in coronary interventions, emphasizing their established use in in-stent restenosis (ISR) and small vessel disease, while exploring emerging applications in large vessels, bifurcation lesions, diffuse coronary artery disease (CAD), and high bleeding risk patients.

Evidence Acquisition: This narrative review was conducted based on recent literature on DCB. A literature search was performed using the keywords "drug coating balloon," "drug coating stent," and "indication." Articles published in English between 2015 and 2025 were included, while those with incomplete data, irrelevant content, or without full-text access were excluded.

Results: Drug-coated balloons could be useful for cases where drug-eluting stents (DES) are restricted. It might also offer a fresh choice for independent balloon angioplasty. This approach replaces DES and bioresorbable scaffolds (BRS). Drug-coated balloons can be used for ISR, small and large vessel lesions, bifurcation lesions, long diffuse disease, acute coronary syndromes, and high bleeding risk patients.

Conclusions: These cases can use DCB as a therapeutic option compared to DES, showing that DCB is effective and safe.

Keywords: Drug Coating Balloon, Drug Coating Stent, Indication

1. Context

There is ongoing debate about the best way to treat coronary lesions The latest drug-eluting stents (DES) are now seen as the preferred option for treating coronary lesions due to their reduced risk of in-stent restenosis (ISR) and stent thrombosis compared to bare-metal stents and older versions of DES (1). Yet, a new idea of "zero waste" has appeared in the last ten years to tackle issues related to stents placed late (such as repeated ISR - ISR, numerous stent layers, or reduced vasomotor function) and prevent stenting in areas where a coronary bypass may be needed (2). The first generation of bioresorbable scaffolds (BRS) did not show at least non-inferiority compared to currently available DES despite being developed in line with this concept (3). As a result, drug-coated balloons (DCBs) have become increasingly popular in recent years as another technology that aligns with the "stentless" idea (4). While the concept of administering antiproliferative drugs like paclitaxel or sirolimus directly to the coronary lesion to avoid restenosis is not brand new, advancements in balloons and excipients have helped overcome the initial issues with tissue absorption and drug retention. Since then, various DCBs have been introduced in the European market, with evaluations of their different uses conducted in registries and RCTs (5). This review aims to summarize the current evidence on the use of DCBs in coronary interventions, highlighting their established role in treating ISR and de novo small

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vessel disease, while also exploring emerging applications in de novo large vessels, bifurcation lesions, and diffuse coronary artery disease (CAD). Additionally, the review addresses the potential benefits of DCBs for patients at high bleeding risk, emphasizing their role as a stentless alternative that may optimize outcomes in specific clinical scenarios.

2. Evidence Acquisition

This article was prepared using a narrative review approach based on recent scientific literature discussing DCB. The process began with a literature search using the keywords "drug coating balloon," "drug coating stent," and "indication." The inclusion criteria comprised articles published within the last ten years (2015 - 2025) and written in English. The exclusion criteria included articles with incomplete or irrelevant data to the topic and those with limited full-text access.

3. Results

3.1. Current Evidence of Drug-Coated Balloons Indication: In-Stent Restenosis

The greatest amount of evidence currently available pertains to the use of DCB for treating ISR. Up to now, multiple RCTs have been released, validating the safety and effectiveness of DCBs in this specific use (6). According to their research, the use of DCBs for ISR is backed by the European Society of Cardiology recommendations (class IA) and is currently the only approved use for these devices. Significantly, the most extensive patient data meta-analysis of 10 RCTs revealed a slightly increased occurrence of the primary efficacy outcome of target-lesion revascularization (TLR) after three years in patients who received paclitaxel-coated balloons in comparison to DES (16.0% vs. 12.0%; P = 0.02). However, there was no notable variation concerning the main safety measure (a combination of all-cause death, heart attack, or target lesion thrombosis), with a slightly lower occurrence in the DCB group (9.0% vs. 10.9%; P = 0.18) (6). This emphasizes the importance of conducting more adequately powered RCTs to assess the potential overall advantages of the stentless method for ISR. Also, due to variations in how sirolimus and paclitaxel work in pharmacodynamics and pharmacokinetics, it is unlikely that there is a common effect among them, therefore, it is preferable to compare different DCB directly.

3.2. Small Vessel Disease

The suboptimal effectiveness of DES in small vessels (< 3 mm) new lesions has naturally prompted the utilization of DCBs in this scenario. While the evidence is not as strong as ISR, the preliminary results from the first RCTs show promise (7). The PICCOLETO II trial's 3-year results demonstrate DCB's superiority over modern DES in clinical outcomes (major adverse cardiac events and acute vessel occlusion) for the first time (7). This could be linked to delayed expansion of the blood vessels seen in individuals who received paclitaxel-coated balloons (and to some extent with limus-based DCBs) and reduced duration of dual antiplatelet therapy (DAPT) (7). Alternatively, less experienced operators may find it difficult to use DCB due to issues like elastic recoil and dissections, which are common reasons for bailout stenting. This could impact the external validity of DCB trials done in high-volume centers.

3.3. De novo Large Vessel Coronary Disease

Recently, DCBs are now being used experimentally for de novo large vessel CAD. While there is no published data from randomized trials evaluating the DCB-based approach in large vessels, the findings from observational studies show promise. Rosenberg et al. (8) presented the results of 234 patients who had newly developed CAD and were treated with SeQuent Please® DCB, separated by vessel diameter below or above 2.75 mm. By nine months, the researchers noted a similar rate of major adverse cardiovascular events (MACE) of 5.7% in small vessel CAD and 6.1% in large vessel CAD (P = 0.903). The frequency of TLR was also deemed acceptable and showed no significant difference between the two groups (3.8% and 1.0%, P = 0.20). Uskela et al. (9) looked back at 487 DCB procedures in 562 new complex lesions, with 60% found in vessels ≥ 3.0 mm and 79% over 2.75 mm. The MACE rate was reported at 7.1% for stable CAD and 12% for ACS at the 12-month mark. The occurrence of TLR was also minimal, with rates of 1.4% for stable CAD and 2.8% for ACS (9).

3.4. Long, Diffuse, Bifurcation Coronary Disease

Long diffuse de novo CAD is increasingly becoming an issue for patients undergoing Percutaneous Coronary Intervention (PCI), with the overall stent length being a separate factor in predicting ISR and stent thrombosis (10). Recent data indicates that when dealing with long and diffuse lesions, one can consider using a strategy that involves either solely using a DCB or using a combination of DCB and spot stenting. Preliminary data indicates that these approaches might be as effective as or even superior to relying solely on

DES (11, 12). Around 20% of PCI procedures that involve a bifurcation are connected to the occlusion of a side-branch and the requirement for further intervention (13). Drug-coated balloons has been suggested as a substitute for a regular balloon angioplasty in the stepwise provisional stenting strategy for true coronary bifurcation lesions (14). In contrast to using two stents, employing DCB in the side branch avoids issues like insufficient stent coverage in the bifurcation, scaffolding at the ostium, deformation of the main branch stent, or the risk of crushing multiple metal layers and polymers. Furthermore, DCB is theoretically more effective than a standard balloon in terms of vascular remodeling, plaque stabilization, and late angiography results (15).

3.5. Acute Coronary Syndromes and High Bleeding Risk

Drug-coated balloons use shows promise for treating acute coronary syndromes (16, 17). In the case of ST-elevation myocardial infarction, factors like lesion morphology (often short and noncalcified), patients' clinical profiles (younger age), and a prothrombotic environment may be conducive to the stent-less approach (17). While there are theoretical benefits of DCBs in acute coronary syndromes that could exceed those in stable de novo lesions, the existing evidence is based on only a small number of RCTs and observational studies. Therefore, more trials are needed to evaluate the effectiveness of DCB in this particular scenario (16, 17). Stent placement might necessitate strong and long-lasting DAPT, leading to a higher chance of bleeding and therefore a greater risk of stopping DAPT prematurely (18, 19). Transporting a drug that inhibits cell growth to the coronary artery wall without inserting a metal stent greatly lowers the chance of vessel clotting (20). Therefore, it seems reasonable to shorten the DAPT regimen after DCB treatment to decrease both bleeding and, indirectly, ischemic complications.

4. Conclusions

Drug-coated balloons serves as a substitute for DES in the treatment of ISR and de novo small vessel disease. Furthermore, there is no escaping the need for additional indications for DCB. The use of DCB in treating newly formed large coronary vessels, bifurcation lesions, and diffuse CAD shows great potential as a new field. Patients who have a high risk of bleeding may also benefit from DCB, particularly given the growing age of individuals undergoing PCI.

Footnotes

Authors' Contribution: Study concept and design: S. L.; Acquisition of data: S. L.; Analysis and interpretation of data: S. L.; Drafting of the manuscript: S. L. and W. W.; Critical revision of the manuscript for important intellectual content: S. L.; Statistical analysis: S. L.; Administrative, technical, and material support: S. L. and W. W.; Study supervision: SL.

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