Case Report

Beyond Guidelines: Early DCB Intervention and Plant-Based Diet as Lifesaving Strategies

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Abstract

We present a case involving a 48-year-old asymptomatic male with a constellation of coronary artery disease (CAD) risk factors, including obesity, hypertension, untreated hyperlipidaemia, untreated prediabetes, and a significant family history of premature CAD. An initial assessment performed at an external facility via computed tomography coronary angiography (CTCA) revealed a moderate stenosis within the left circumflex artery (LCX), which was subsequently confirmed as an 80% luminal narrowing by invasive coronary angiography (ICA). Since a fractional flow reserve (FFR) greater than 0.8 was obtained, the decision was made to defer percutaneous coronary intervention (PCI) and manage conservatively with optimal medical therapy (OMT), albeit without structured lifestyle modification guidance.

Three months following this initial evaluation, the patient presented emergently to Bethsaida Hospital under the care of Prof. Dasaad Mulijono with an acute myocardial infarction (AMI) due to acute total occlusion (100%) of the LCX with reduced LV (EF of 40%). Following emergent PCI, an aggressive lifestyle intervention strategy, encompassing stringent metabolic optimization and a transition to a plant-based diet (PBD), was initiated. This integrative approach yielded substantial clinical improvements. At one-year follow-up, the patient's left ventricular ejection fraction (LVEF) had markedly improved to 60%, and he exhibited no clinical symptoms indicative of ischemia or heart failure.

This clinical scenario highlights the critical implications of under-recognized vulnerable plaques (VPs), inadequate assessment of patient vulnerability, and insufficient communication between patients and providers during initial therapeutic decision-making.

This case report highlights the substantial therapeutic potential of comprehensive lifestyle modifications, particularly a PBD, in reversing the progression of atherosclerosis, mitigating restenosis, and improving outcomes in heart failure. Additionally, we propose critical considerations supporting the early utilization of drug-coated balloon (DCB) angioplasty for coronary lesions exhibiting stenosis <90%, especially in patients likely to exhibit suboptimal adherence to medical therapy alone.

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Introduction

PCI remains essential for managing chronic coronary syndrome (CCS). It is primarily recommended for symptomatic patients or lesions with a high ischemic risk (stenosis ≥90%), as per the 2024 ESC and 2023 AHA/ACC guidelines [1,2]. However, challenging cases arise involving severe but sub-90% lesions in patients unlikely to adhere to OMT. Here, we present a rationale for considering early DCB angioplasty in such patients.

Case Presentation

A 48-year-old asymptomatic male with metabolic syndrome presented with multiple coronary risk factors, including obesity (BMI 30 kg/m²), controlled hypertension (on ARB and calcium channel blocker), untreated hyperlipidaemia (LDL 180 mg/dL, HDL 30 mg/dL, triglycerides 200 mg/dL), untreated prediabetes (HbA1C 6.2%), and positive family history of CAD. Initial CTCA at a government hospital identified moderate LCX stenosis (calcium score 320 HU), confirmed as 80% stenosis on invasive angiography (FFR >0.8). PCI was deferred in accordance with the guidelines, and OMT (beta-blockers, ARBs, statins, and ticagrelor) was initiated; however, lifestyle interventions were not adequately addressed.

Three months later, he presented at our institution with acute LCX occlusion causing AMI, elevated cardiac enzymes, and uncontrolled coronary risk factors following medication discontinuation. Emergency PCI restored coronary flow. Subsequently, intensive lifestyle modifications were implemented, emphasizing adherence to PBD and strict metabolic targets.

Nine-month follow-up showed significant clinical improvements: BMI 22 kg/m², LDL <58 mg/dL, HbA1C normalized, triglycerides 130 mg/dL, HDL 40 mg/dL, and optimal blood pressure control. After one year, further improvements were observed: BMI 21 kg/m², LDL 38 mg/dL, triglycerides 80 mg/dL, HDL 44 mg/dL, HbA1C 5.5%, sustained optimal blood pressure, and LVEF improved to 60%. Repeat CTCA demonstrated patent LCX and stable calcium score (305 HU), with the patient remaining symptom-free.

Discussion

This case underscores several crucial clinical insights pertinent to managing patients with coronary stenosis of less than 90% who exhibit significant cardiovascular risk profiles. The initial management strategy employed by the governmental hospital appropriately adhered to contemporary clinical guidelines, specifically deferring invasive intervention based on fractional flow reserve (FFR) measurements surpassing the established threshold (>0.8) [3-5]. Nonetheless, significant clinical oversights

were evident, including the potential misclassification of the patient's vulnerability status and inadequate identification of VPs [6-12]. Such lapses predominantly stemmed from the absence of detailed plaque characterization through advanced CTCA and the omission of essential intravascular imaging modalities, such as intravascular ultrasound (IVUS) or optical coherence tomography (OCT) [13-17]. These modalities are instrumental in accurately identifying plaque vulnerability characteristics, which have a profound impact on clinical decision-making and patient prognosis.

Moreover, the treatment plan notably lacked a comprehensive approach towards lifestyle intervention and patient education. Adequate patient education is indispensable, particularly regarding the inherent limitations and accuracy of diagnostic evaluations, as well as the ongoing risks of adverse cardiac events despite initially reassuring test outcomes. Comprehensive educational engagement is crucial for emphasizing adherence to pharmacological therapy, lifestyle modification strategies, and structured follow-up plans, ultimately enhancing patient compliance and clinical outcomes.

Had the patient presented initially to our institution, a more meticulous and integrated approach would have been pursued, particularly emphasizing advanced diagnostic assessment of plaque vulnerability. Specifically, our institution's advanced CTCA technology, augmented with artificial intelligence (AI), provides a nuanced capability for precise identification and stratification of VPs, characterized by features such as positive remodelling, low-attenuation lipid cores, spotty calcification, and napkin-ring signs [18-21].

Given the patient's constellation of uncontrolled metabolic risk factors and anticipated medication non-adherence, an early interventional strategy employing DCB angioplasty would have represented a prudent therapeutic choice. This approach aims to stabilize plaque [22-26] and mitigate lesion progression without exposing the patient to long-term complications typically associated with stent implantation and prolonged dual antiplatelet therapy, which might pose adherence challenges for specific patient populations.

Supporting this strategic approach, robust evidence from imaging studies employing coronary CT angiography has elucidated that plaque morphology significantly correlates with cardiac event risks. Specifically, recent research has demonstrated the following associations [27,28]:

- Patients presenting with VPs accompanied by significant stenosis (>70%) carry a markedly elevated cardiac event risk (30-fold higher).

- Patients with VPs and non-significant stenosis (<70%) still exhibit a substantially increased risk (25-fold higher).

- Conversely, patients with significant stenosis without vulnerability markers demonstrate a moderately elevated

risk (4-fold higher), whereas non-VPs with minimal stenosis pose only a modest risk elevation (approximately 2-fold).

These findings underscore the critical clinical importance of focusing not only on stenosis severity but also on comprehensive plaque characterization to accurately predict and prevent adverse cardiovascular events.

Strict adherence to clinical guidelines without a nuanced interpretation informed by emerging literature and meticulous clinical judgment might compromise patient safety and expose healthcare providers to legal vulnerability. Therefore, integrating current scientific evidence, clinical expertise, and individualized patient risk profiling is paramount in achieving optimal patient outcomes.

Bethsaida Hospital's clinical approach integrates comprehensive strategies to address potential patient noncompliance. Dedicated personnel proactively engage patients through regular telephone follow-ups and home visits. Furthermore, our clinical decisions are augmented by sophisticated AI-driven risk assessment tools [29-32], designed to evaluate the relative risks of intervention versus conservative management in patients presenting complex cardiovascular risk profiles. This approach enhances patient safety and clinical efficacy, significantly mitigating medicolegal risks.

A profound understanding of basic sciences, such as vascular biology and plaque histopathology, is integral to accurately identifying which lesions are predisposed to progression and potential acute coronary syndromes, particularly in patients with systemic metabolic disorders [33-36]. Given the patient's multiple metabolic abnormalities contributing to plaque development and instability, a dual approach combining procedural interventions (e.g., DCB angioplasty) with systemic management (e.g., aggressive lifestyle and metabolic modifications) should be rigorously implemented [22-26,37-41].

In summary, the criteria justifying early intervention with DCB in cases of coronary stenosis below 90% should include:

- Objective evidence of ischemia or the presence of high-risk plaque features.

- Anticipated challenges in patient adherence to OMT.

- Elevated risk of rapid lesion progression secondary to uncontrolled metabolic factors.

Thus, a robust, multidimensional management framework incorporating comprehensive patient education, clearly defined metabolic and lifestyle modification targets, including adoption of PBD strategies, and meticulous longitudinal follow-up—is essential to effective cardiovascular risk reduction and enhanced patient outcomes.

DCB intervention strategy in <90% stenosis

- Objective evidence of ischemia or the presence of high-risk plaque features.

- Anticipated challenges in patient adherence to OMT.

- Elevated risk of rapid lesion progression secondary to uncontrolled metabolic factors.

Conclusion

This case highlights several critical lessons for clinical management of CCS, particularly regarding patients presenting with coronary stenosis below the conventional intervention threshold of 90%. Key insights include:

1. Beyond Guideline-Based Decisions: Strict adherence to current guidelines, which recommend conservative management for lesions with fractional flow reserve (FFR) >0.8, may inadvertently overlook VP characteristics and patient-specific risks, potentially leading to acute cardiac events. Clinicians must employ comprehensive plaque assessment tools, including advanced CTCA, IVUS, or OCT, to accurately identify VPs.

2. Early DCB Intervention: For patients with substantial coronary risk factors, metabolic syndrome, and predicted poor adherence to OMT, early use of DCB angioplasty can effectively stabilize VPs, prevent acute plaque rupture, and minimize the need for stenting and prolonged dual antiplatelet therapy. Early intervention should be considered when VP features and significant metabolic risk factors are detected [23].

3. Structured Lifestyle Intervention and Patient Education: Effective cardiovascular management extends beyond pharmacological intervention. Comprehensive patient education and structured lifestyle interventions, notably adopting a PBD coupled with rigorous metabolic control, significantly enhance long-term patient outcomes, reduce restenosis rates, reverse atherosclerotic progression, and improve cardiac function.

4. Integrated Clinical Approach and Follow-up: A multidimensional and patient-centred clinical approach, including structured follow-up with regular patient engagement through telemedicine or home visits, reinforces patient adherence, optimizes clinical outcomes, and reduces the risk of acute coronary events.

5. Advanced Technology and AI Integration: Utilizing advanced imaging techniques in conjunction with AI enables accurate risk stratification, facilitating the

development of personalized management strategies. AI-supported decision-making facilitates the identification of high-risk patients who may benefit significantly from early interventional approaches, thus enhancing patient safety and reducing medicolegal risks.

Adopting a holistic, nuanced clinical strategy integrating aggressive lifestyle modification (especially PBD), early strategic intervention (DCB), and advanced risk assessment methodologies is critical for improving patient prognosis, preventing acute coronary syndromes, and promoting cardiovascular health.

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