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Review Article

# Iatrogenic Left Main Coronary Artery Stenosis Following Interventional and Surgical Procedures: A Literature Review

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## Abstract

Iatrogenic left main coronary artery (LMCA) stenosis is a rare but life-threatening complication that may occur after percutaneous coronary intervention (PCI) or cardiac valve surgery. While initially uninvolved, the LMCA can develop significant stenosis months after manipulation of other coronary vessels, raising diagnostic and therapeutic challenges. This review aims to synthesize existing case reports and clinical experiences regarding the development of iatrogenic LMCA stenosis in patients with no prior LMCA lesions, focusing on procedural causes and subsequent treatment strategies. A comprehensive review of the literature identified and analyzed a total of 14 publications comprising 8 multi-patient case series, 4 single case reports, and 1 retrospective cohort were identified, who developed iatrogenic LMCA stenosis following PCI or aortic valve surgery. Mechanisms, clinical presentations, diagnostic approaches, and outcomes of various treatment modalities were analyzed. The most common mechanisms included catheter-induced trauma, balloon overdistension, and ostial cannulation during valve surgery. Clinical presentation ranged from recurrent angina to cardiogenic shock. Treatment strategies included coronary artery bypass grafting, percutaneous coronary angioplasty with stenting, and in select hemodynamically stable patients, conservative medical therapy. PCI was often reserved for high-risk surgical patients or when rapid revascularization was essential. Iatrogenic LMCA stenosis should be considered in patients presenting with angina after coronary or valvular interventions, especially in the absence of prior LMCA disease. Early recognition through angiography and appropriate selection of revascularization strategy, surgical or percutaneous, is critical for optimizing outcomes.

**Keywords:** Coronary angioplasty percutaneous transluminal; coronary artery bypass; coronary artery disease; coronary stenosis; coronary vessels injuries; heart valve prosthesis implantation.

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# Girişimsel ve Cerrahi İşlemler Sonrası Gelişen İyatrojenik Sol Ana Koroner Arter Darlığı: Bir Literatür Derlemesi

## Özet

Bu derlemenin amacı, başlangıçta LMCA lezyonu olmayan hastalarda PKG veya aort kapak cerrahisi sonrası gelişen iyatrojenik LMCA stenozuna dair olgu sunumları ve klinik deneyimleri sentezlemektir. Çalışma, bu durumun oluşum mekanizmalarına ve sonrasında uygulanan tedavi stratejilerine odaklanmaktadır. Literatürün kapsamlı bir incelemesi sonucunda, 8 çok hastalı olgu serisi, 4 tek olgu sunumu ve 1 retrospektif kohort çalışmasından oluşan toplam 14 yayın belirlenmiş ve analiz edilmiştir. Mekanizmalar, klinik bulgular, tanı yaklaşımları ve farklı tedavi yöntemlerinin

sonuçları analiz edilmiştir. En sık karşılaşılan oluşum mekanizmaları arasında kateter kaynaklı travma, balonun aşırı şişirilmesi ve kapak cerrahisi sırasında ostial kanülasyon yer almaktadır. Klinik tablolar tekrarlayan anjinadan kardiyojenik şoka kadar değişkenlik göstermektedir. Tedavi seçenekleri arasında koroner arter bypass greftleme (CABG), stentle perkütan koroner anjiyoplasti ve seçilmiş hemodinamik olarak stabil hastalarda konservatif tıbbi tedavi yer almaktadır. PKG genellikle cerrahi riski yüksek olan hastalarda ya da hızlı revaskülarizasyonun gerekli olduğu durumlarda tercih edilmiştir. Koroner veya kapak girişimi sonrası anjina ile başvuran ve önceden LMCA hastalığı bulunmayan hastalarda iyatrojenik LMCA stenozu göz önünde bulundurulmalıdır. Anjiyografi ile erken tanı ve cerrahi ya da perkütan tedavi yöntemlerinden uygun olanının seçimi, hasta sonuçlarını iyileştirmede kritik öneme sahiptir.

**Anahtar sözcükler:** Perkütan translüminal koroner anjiyoplasti; koroner arter bypass greftleme; koroner arter hastalığı; koroner darlık; koroner damar yaralanmaları; kalp kapak protezi implantasyonu.

## Introduction

Iatrogenic complications have become increasingly recognized in the context of the expanding use of interventional cardiology procedures. Among these, left main coronary artery (LMCA) stenosis represents a rare but potentially life-threatening complication. Particularly concerning are cases in which patients with previously normal LMCA anatomy develop significant stenosis following percutaneous coronary intervention (PCI) performed on other coronary vessels.

In addition to percutaneous interventions, iatrogenic LMCA stenosis has also been reported after various cardiac surgical procedures, most notably aortic valve replacement (AVR). During AVR, the proximity of the LMCA ostium to the aortic annulus renders it vulnerable to direct or indirect injury. Several mechanisms have been proposed, including mechanical trauma from antegrade cardioplegia cannulas, coronary ostial perfusion catheters, or suture placement near the left coronary ostium. Furthermore, post-operative inflammatory reactions and fibrointimal proliferation secondary to endothelial injury may contribute to delayed LMCA narrowing.

The pathogenesis of iatrogenic LMCA stenosis is typically attributed to direct mechanical trauma from guiding catheters, balloon overdistension causing arterial wall injury, or ostial cannulation during valve Surgery.[1,2] The onset of clinical symptoms generally occurs within a time frame of weeks to months post-procedure, most frequently manifesting as recurrent angina, ventricular arrhythmias, or myocardial infarction.

Diagnosis is typically made by coronary angiography upon recurrence of symptoms. Management strategies vary depending on the patient's clinical stability, comorbidities, and anatomical considerations. While coronary artery bypass grafting (CABG) remains the standard treatment, PCI has shown promise in high-risk surgical patients or those who decline surgery.[3]

In this review, we summarize the existing literature on cases of iatrogenic LMCA stenosis that developed after coronary or valvular interventions in patients with no prior LMCA disease. We examine the underlying mechanisms, clinical presentations, and treatment approaches, with the goal of increasing awareness of this serious complication and guiding optimal management strategies.

## Materials and Methods

### Data Sources and Search Strategies

This systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines and the Cochrane Handbook for Systematic Reviews of Interventions (version [insert version, e.g., 6.4]). A comprehensive search of the literature was performed using the PubMed database without restrictions on publication date or language. The following search terms were used in various combinations with Boolean operators: "iatrogenic," "left main coronary artery," "LMCA," "stenosis," "percutaneous coronary intervention," "PTCA," "aortic valve surgery," "heart valve replacement," and "catheter-induced injury."

In addition, reference lists of included articles were manually screened to ensure a comprehensive search. Grey literature and conference abstracts were not included in the analysis.

### Eligibility and Criteria

Studies were eligible for inclusion if they reported one or more cases of newly developed iatrogenic LMCA stenosis occurring after PCI or aortic valve surgery in patients with no pre-existing LMCA disease. Articles needed to provide angiographic or clinical evidence of LMCA involvement and include diagnostic approaches and treatment strategies. Exclusion criteria included studies describing spontaneous or atherosclerotic LMCA stenosis unrelated to interventional procedures, those lacking sufficient clinical detail or outcome data, and non-clinical publications, such as editorials, expert opinions, or reviews without original case data. Only human studies were included in the analysis.

### Data Characterization, Summary, and Synthesis

For each included article, we extracted information on study type (case report or series), patient demographics, index procedure type (PCI or aortic valve surgery), time to symptom onset, clinical presentation, diagnostic methods, and proposed mechanism of LMCA injury, treatment strategy, and outcomes.

Due to the heterogeneity and descriptive nature of the included reports, we did not perform a meta-analysis or pooled quantitative synthesis. No formal risk of bias assessment was conducted, as most included studies were single-case reports with limited methodological data. Instead, we summarized and categorized the clinical characteristics and management strategies in a qualitative synthesis.

## Results

A total of 14 publications comprising 8 multi-patient case series, 4 single case reports, and 1 retrospective cohort were identified who developed iatrogenic LMCA stenosis after PCI or aortic valve surgery, despite having previously normal LMCA anatomy.

The onset interval from the index procedure to the development of symptoms ranged from 3 weeks to 19 months (mean: 4.7 months). The most frequent presentation was angina pec-

**Table 1. A summary of the reported mechanisms, associated procedures, and corresponding treatment strategies from the relevant literature is presented**

| Reference no. | Authors | Main topic/finding | Year | Treatment strategy |
|---|---|---|---|---|
| 1 | Bashour et al.[1] | LMCA stenosis post-PTCA/valve surgery | 1985 | CABG |
| 2 | Pande and Gosselin[2] | Mechanism of LMCA injury in surgery | 1995 | CABG |
| 3 | Martí et al.[3] | PCI alternative to CABG in LMCA | 1995 | PCI |
| 4 | Wayne et al.[4] | LMCA stenosis after PTCA | 1988 | CABG |
| 5 | Siddiqui et al.[5] | Catheter-induced LMCA stenosis | 2012 | CABG |
| 6 | Akchurin et al.[6] | LMCA progression post-stenting | 2012 | CABG |
| 7 | Daniel et al.[7] | LMCA stenosis after SAVR | 2025 | CABG |
| 8 | Ogawa et al.[8] | Perfusion catheter-related LMCA injury | 1993 | CABG |
| 9 | Yavuz et al.[9] | Bilateral coronary stenosis after AVR | 2002 | CABG |
| 13 | Quiret et al.[13] | PTCA-induced intimal injury | 1990 | CABG |
| 14 | Dibie et al.[14] | Incidence and cause of LMCA stenosis | 2002 | CABG |
| 15 | Funada et al.[15] | LMCA stenosis post-AVR | 2006 | PCI |
| 16 | Hamad et al.[16] | Late LMCA stenosis after PTCA | 1987 | CABG |
| 17 | Cola et al.[17] | LMCA stenosis post-AVR | 2009 | PCI |

AVR: Aortic valve replacement; CABG: Coronary artery bypass grafting; CT: Computed tomography; IVUS: Intravascular ultrasound; LMCA: Left main coronary artery; MI: Myocardial infarction; PCI: Percutaneous coronary intervention; PTCA: Percutaneous transluminal coronary angioplasty.

**Table 2. Summarizes the clinical presentations, timing of symptom onset, and diagnostic modalities reported across the included cases of iatrogenic LMCA stenosis**

| Reference no. | Authors | Time to symptom onset | Clinical presentation | Diagnostic modality |
|---|---|---|---|---|
| 1 | Bashour et al.[1] | Weeks to months | Angina, MI | Coronary angiography |
| 2 | Pande and Gosselin[2] | Weeks | Recurrent angina | Coronary angiography |
| 3 | Martí et al.[3] | 2–3 months | Angina, ischemia on stress test | Angiography |
| 4 | Wayne et al.[4] | 1–2 months | MI, unstable angina | Coronary angiography |
| 5 | Siddiqui et al.[5] | Weeks | Post-PCI angina | Angiography |
| 6 | Akchurin et al.[6] | 2–6 months | Recurrent angina | Coronary angiography |
| 7 | Daniel et al.[7] | 4 months | Angina, heart failure | Coronary angiography |
| 8 | Ogawa et al.[8] | Weeks | Post-AVR angina | Coronary angiography |
| 9 | Yavuz et al.[9] | 1 month | Angina, heart failure | Angiography |
| 13 | Quiret et al.[13] | Days to weeks | Angina, restenosis | Coronary angiography |
| 14 | Dibie et al.[14] | 3–12 months | Angina, incidental finding | Coronary angiography |
| 15 | Funada et al.[15] | 4–8 weeks | Hemodynamic collapse | CT + Coronary angiography |
| 16 | Hamad et al.[16] | Weeks | Angina | Coronary angiography |
| 17 | Cola et al.[17] | Weeks | Post-AVR ischemia | Angiography |

AVR: Aortic valve replacement; CABG: Coronary artery bypass grafting; CT: Computed tomography; IVUS: Intravascular ultrasound; LMCA: Left main coronary artery; MI: Myocardial infarction; PCI: Percutaneous coronary intervention; PTCA: Percutaneous transluminal coronary angioplasty.

toris (reported in 12 patients, 67%), followed by acute coronary syndrome or myocardial infarction (4 patients, 22%) and heart failure or arrhythmia (2 patients, 11%).

Coronary angiography was the primary diagnostic tool in all cases, while intravascular ultrasound or computed tomography (CT) was used in recent reports for detailed assessment of ostial involvement.

Regarding management, CABG was performed in 10 cases (56%), PCI in 6 cases (33%), and conservative medical management in 2 cases (11%).

Across all reports, the dominant pathophysiological mechanism was catheter- or cannulation-induced endothelial trauma followed by fibrointimal proliferation, resulting in delayed luminal narrowing.

## Mechanisms and Etiology

Multiple mechanisms of injury have been described in the literature. A summary of the reported mechanisms, associated procedures, and corresponding treatment strategies from the relevant literature is presented in Table 1. Table 2 summarizes the clinical presentations, timing of symptom onset, and diagnostic modalities reported across the included cases of iatrogenic LMCA stenosis.

## Discussion

Iatrogenic LMCA stenosis is an uncommon but serious complication observed after interventional procedures, such as PCI, PTCA, and cardiac valve surgery. Although the LMCA is often not directly manipulated in these procedures, a growing number of case reports suggest that trauma related to catheter use, balloon inflation, or surgical perfusion techniques can cause the delayed onset of LMCA narrowing even in patients with no prior LMCA disease.

In PCI-related cases, inadvertent trauma from guiding catheters or high-pressure balloon dilation of proximal LAD or LCx segments may cause retrograde damage extending into the LMCA, resulting in intimal injury, and ultimately fibrosis.[1,4,5] Similarly, repeated PCI in complex lesions or bifurcation stenting with "kissing balloon" techniques have been associated with LMCA involvement, especially when backup catheters are used in anatomically small vessels.[6]

In surgical cases, such as valve replacements, direct ostial cannulation during antegrade cardioplegia has been implicated in LMCA damage. Daniel et al.[7] reported a case of LMCA ostial stenosis developing four months after surgical AVR, likely caused by mechanical trauma from antegrade cardioplegia cannulation and high perfusion pressure, resulting in endothelial injury and subsequent fibrointimal hyperplasia leading to progressive luminal narrowing. AVR, in particular, carries this risk due to proximity to the coronary ostia. Perfusion catheters, especially rigid or oversized ones, can exert mechanical pressure on the LMCA ostium, leading to endothelial trauma and later fibrointimal proliferation.[2,8,9]

Similarly, in transcatheter aortic valve implantation (TAVI), coronary obstruction may occur through distinct but primarily mechanical mechanisms, rather than intimal injury. In most cases, obstruction results from displacement of bulky or calcified native leaflets toward the coronary ostia during valve deployment, or occlusion caused by low coronary ostial height and narrow sinuses of Valsalva, which restrict coronary outflow. Less frequently, obstruction may result from the interaction between the transcatheter valve frame or prosthetic leaflets and the coronary orifice, especially in valve-in-valve procedures.[10–12] These mechanisms typically produce acute coronary obstruction during or immediately after valve implantation, often manifesting as sudden hemodynamic collapse or ST-segment elevation. However, late coronary obstruction after TAVI reported in the Spanish TAVI Registry may develop weeks or months later due to delayed prosthetic leaflet malposition or progressive thrombus and neointimal proliferation around the coronary ostium.[10] This pathophysiology differs substantially from the delayed fibrointimal proliferation related LMCA stenosis observed after surgical valve replacement or percutaneous interventions in our review.

Quiret et al.[13] described four patients who developed LMCA or nearby stenoses shortly after PTCA, attributing the mechanism to intimal damage caused by the guiding catheter or distal hardware, such as the balloon or guidewire. These injuries led to fibrotic healing and progressive luminal narrowing, highlighting the procedural sensitivity of the LMCA even in interventions targeted at its branches.

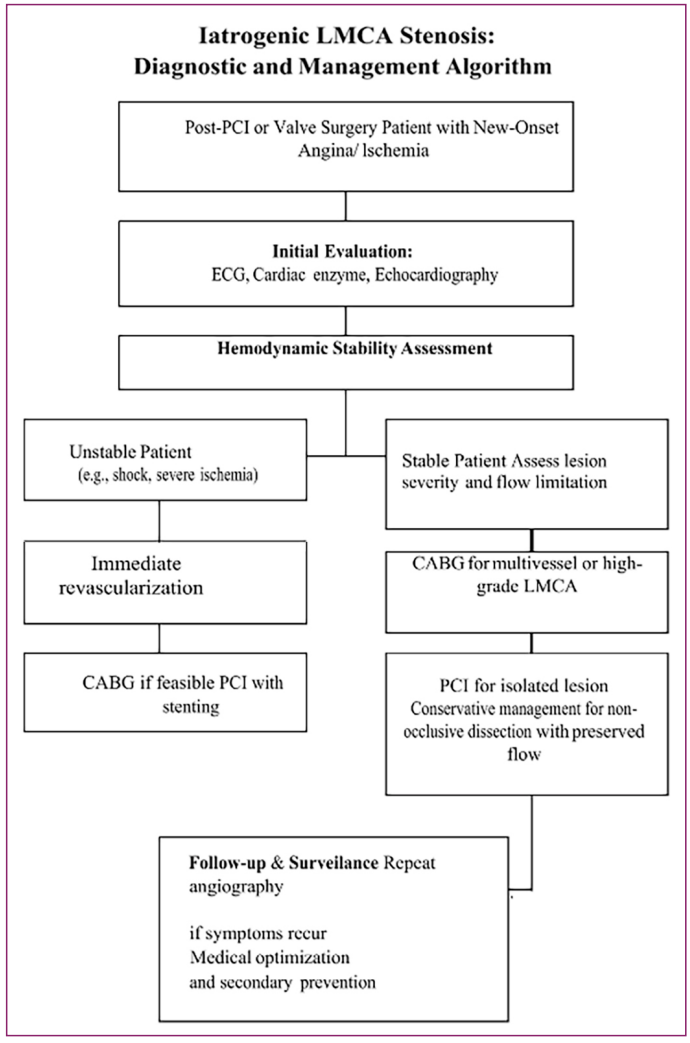


**Figure 1.** A proposed diagnostic and therapeutic decision-making algorithm is presented.

Dibie et al.[14] reported five cases of LMCA stenosis diagnosed 3–12 months after prior angioplasty, again in patients without prior LMCA involvement. Their study emphasized the rarity but significance of this phenomenon (0.2–1.7% incidence), attributing it to traumatic manipulation during PTCA and comparing their findings with earlier reports on valve surgery–related injury.

Most patients present within 1–6 months of the index procedure with symptoms, such as exertional angina, unstable angina, or myocardial infarction. In some cases, patients may experience sudden hemodynamic collapse due to acute LMCA occlusion.[15] Repeat coronary angiography is the gold standard for diagnosis, although CT angiography has shown promise in early detection, especially in post-operative cases.[15]

Management must be individualized based on clinical stability, extent of stenosis, and surgical candidacy. A proposed diagnostic and therapeutic decision-making algorithm is presented in Figure 1 to aid clinicians in managing suspected cases of iatrogenic LMCA stenosis following coronary or valvular interventions. CABG remains the preferred option for most patients,

especially those with multivessel disease or high-grade LMCA stenosis.[9,16] In Akchurin's retrospective cohort, all patients with newly developed LMCA stenosis after PCI were successfully treated with CABG, suggesting this remains a reliable and effective strategy for complex cases.[6] However, several cases have demonstrated successful treatment with PCI and drug-eluting stents, particularly in patients at high surgical risk or with isolated LMCA lesions.[3,17]

### Study Limitations

The primary limitation of this review lies in its dependence on case reports and small series, which inherently limit generalizability and increase the risk of publication bias. Inconsistent definitions, incomplete procedural data, and the exclusion of non-indexed or non-English studies may further limit the robustness and comparability of findings.

## Conclusion

Iatrogenic LMCA stenosis is a rare but serious complication that may develop weeks to months after PCI or valve surgery, even in patients with initially normal LMCA anatomy. It is primarily caused by catheter trauma, balloon overinflation, or ostial cannulation. Non-specific symptoms, such as recurrent angina require high clinical suspicion and early angiographic evaluation. While CABG remains the standard treatment, PCI is a valid alternative in select patients, and conservative management may be appropriate in stable cases. Early recognition and individualized treatment are essential for improving outcomes.

Our review reinforces the importance of preventive procedural techniques, early recognition, and individualized treatment planning in managing this uncommon but serious complication. Further prospective studies are needed to better understand the true incidence, risk predictors, and optimal long-term management of iatrogenic LMCA stenosis.

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