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Research Article

Overcoming Challenges in Kabul, Afghanistan: Successful Management of Mid-Portion Left Anterior Descending Artery Ellis Class 3 Coronary Artery Perforation, Complicated by Cardiac Tamponade and Concurrent Cardiac Arrest

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Abstract

Background: Coronary artery perforation (CAP) is a rare but life-threatening complication of coronary artery interventions. Despite its rarity, the potential severity of CAP necessitates prompt and effective management strategies, especially in resource-limited settings.

Case Presentation: We report the case of a 60-year-old female who experienced a mid-portion left anterior descending (LAD) artery Ellis class 3 perforation, resulting in cardiac tamponade during stent post-dilation. The patient suffered cardiac arrest but was successfully resuscitated. Faced with limited resources, the medical team managed the perforation with pericardiocentesis followed by the placement of a PTFE-coated stent, achieving TIMI grade 3 flow restorations.

Conclusion: This case underscores the challenges and importance of resourceful management in acute cardiac emergencies. It provides valuable insights into handling CAP under resource-limited settings, emphasizing the critical role of quick decision-making and appropriate interventions in improving patient outcomes

Keywords: Coronary artery perforation (CAP); Cardiac tamponade; Coronary artery interventions; Percutaneous coronary intervention (PCI); Left anterior descending artery (LAD); Ellis class 3 perforation; Cardiac arrest; Resource-limited settings; Pericardiocentesis; PTFE-coated stent; Acute cardiac emergencies

Introduction

Coronary Artery Perforation (CAP) is an uncommon, yet serious risk associated with percutaneous coronary intervention (PCI) and similar cardiac procedures [1]. It arises from accidental damage, leading to the rupture of the coronary arterial wall [2]. CAP's clinical manifestations range from minor, self-limiting hemorrhages to grave complications such as cardiac tamponade, cardiogenic shock, myocardial infarction, and potentially fatal hemorrhaging [3,7].

Research indicates that CAP occurs in approximately 0.1-0.48% of interventions, with associated mortality rates between 7% and 17% [5]. Several factors can increase the likelihood of CAP, including individual patient characteristics, procedural issues, lesion types, and the choice of interventional techniques. Despite the strides made in interventional cardiology tools and techniques, CAP remains a challenging and sometimes unavoidable issue for medical professionals due to the accidental nature of its onset and the significant adverse outcomes that can follow. Timely and effective identification and management are critical to substantially reduce the risk of severe complications [12].

This case study details a particularly notable instance of CAP, examining how its occurrence and resolution align with, or diverge from, the current understanding of CAP. It seeks to provide insights that may aid interventional cardiologists, cardiac surgeons, and others involved in coronary interventions to address coronary artery perforations and enhance overall patient care.

Case Presentation

A 60-year-old female presented to the cardiology unit with exertional chest pain and difficulty breathing, she had been experiencing symptoms, including chest pain upon exertion, shortness of breath, and fatigue, for the past two years. She denied experiencing symptoms like orthopnea, paroxysmal nocturnal dyspnea, heart palpitations, or fainting. However, she described ongoing chest pain, which radiated to her left arm and back over the past two years. A week earlier, she had sought care for similar symptoms and was placed on maximal anginal therapy, with the advice to revisit the outpatient clinic in a week. Upon returning, she was hospitalized and scheduled for a Coronary Angiogram (CAG).

The patient's medical background included ischemic heart disease and high blood pressure. Her medication regimen consisted of atorvastatin 20mg, losartan 50mg, amlodipine 50mg, and bisoprolol 5mg, all taken daily and last administered on the day of her hospitalization. Apart from a depressive disorder, her past medical history was unremarkable. Risk factors for heart disease included her two-year battle with high blood pressure and a family history marked by a brother with ischemic heart disease, but no other noteworthy familial patterns or risk markers for heart disease were present. At admission, the patient exhibited a regular heart rhythm at a pulse rate of 65 beats per minute, blood pressure reading 163/75, normal jugular venous pressure, significant edema, and some paleness. No additional abnormal physical findings were noted. The ECG showed abnormal changes, and the final clinical diagnosis was chronic coronary syndrome.

Initial assessment showed normal lab tests, while the echocardiogram showed normal ejection fraction of 55%, however she had mild aortic regurgitation.

With the patient's agreement, she was transferred to the catheterization laboratory for CAG on the same day. Local anesthesia was achieved with 2% lidocaine. A 6french sheath provided access to the right femoral artery, and specific catheters were employed to assess the left main and right coronary arteries. The angiogram highlighted a two-vessel disease with non-critical narrowing at the beginning and significant stenosis in the middle portion of the left anterior descending artery, and significant stenosis of the right coronary artery which was non-dominant in this patient. We suggested the patient undergoes a coronary angioplasty.

The angioplasty commenced under sterile conditions, with pre-operative administration of Aspirin + clopidogrel 300mg and heparin 8IU. Guiding catheters were inserted into both the left main and right coronary arteries. A 2.25X26 resolute integrity stent was implanted in the left anterior descending artery. Plain Old Balloon Angioplasty (POBA) was performed on the non-dominant right coronary artery (RCA). In the case of the Left Anterior Descending artery (LAD), a stent was initially placed but did not inflate properly. Efforts to post-dilate the stent were made in an attempt to ensure proper deployment. Unfortunately, during these attempts, the LAD was perforated by the stent. This incident resulted in an Ellis type III perforation of the LAD artery, visible in the CAG images, which subsequently led to cardiac tamponade and arrest. The patient was stabilized with inotropes and intubation. Hemodynamic stability was maintained while the team managed the perforation by repeatedly inflating and deflating a balloon, awaiting a cover stent. Resuscitation efforts quickly commenced as the patient's oxygen levels and blood pressure dropped. Mechanical ventilation and vasopressin were initiated to manage the critically low blood pressure. A successful pericardiocentesis alleviated the tamponade, and reinfusion of blood addressed the ongoing blood loss.

In an ideal situation, a PTFE-coated stent would be used to seal an Ellis type III perforation [3], but due to resource limitations, common in lower-income regions like Afghanistan, the hospital did not have this stent available. The required stent was requested from another institution. In the interim, to control bleeding and maintain blood flow, a balloon was repeatedly inflated and deflated until the stent's arrival. This temporary measure succeeded in stabilizing the patient's condition. Upon the delivery of the specialized stent, it was successfully placed in the artery, restoring optimal blood flow. This case exemplifies a remarkable achievement in interventional cardiology, particularly under the constraints of limited resources. The successful completion of such a procedure, in a setting highlights the dedication and expertise of the medical team involved. This case serves as a testament, to the resilience and resourcefulness of healthcare professionals when dealing with adversity demonstrating practice under challenging circumstances.

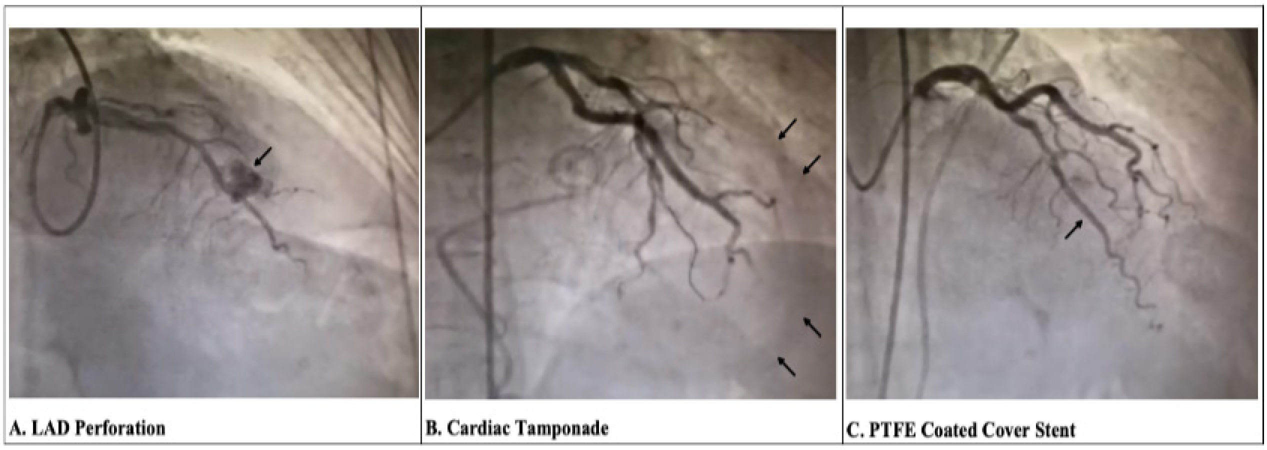

Figure 1: Visual Explanation: Managing Coronary Artery Perforation during Percutaneous Intervention. Part 1A of the figure captures the moment a stent accidentally punctures the left anterior descending artery which led to an ELIS Type III perforation. Part 1B details the subsequent development of cardiac tamponade, characterized by the accumulation of blood within the pericardial sac. Finally, part 1C illustrates the use of a PTFE-coated stent to effectively seal the perforation.

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The patient regained consciousness, and her blood pressure normalized. She remained in a semi-conscious state, necessitating sedation and prolonged mechanical breathing support. An immediate echocardiogram indicated no significant pericardial fluid buildup. The patient was then moved to the critical care unit and remained on ventilator support until she was stable. After two days, she was gradually taken off ventilator support and vasopressor medications. She left the hospital 74 hours later in a stable state, with a prescription for a combination of cardiovascular, antimicrobial, and supplemental medications.

A three-day post-discharge check-up included an echocardiogram, which confirmed her heart's pumping ability was within the expected range. The follow-up assessment indicated a satisfactory recovery. Remarkably, the echocardiogram also showed that the Ejection Fraction (EF) was completely restored in this patient, which is an excellent outcome.

Discussion

Causative factors: Pathophysiology & Etiology

The origin of CAP is accidental during medical intervention, with numerous elements contributing to the risk of perforation during PCI. The likelihood of CAP correlates with the severity of coronary artery disease [4].

Factors frequently contributing to the risk of CAP during PCI include being female, having had previous coronary artery bypass grafting (CABG), chronic kidney disease, advanced age, acute coronary syndrome, high blood pressure, diabetes, and dyslipidemia, as well as diseases of the left main artery and left anterior descending artery [5,6,8,10]. High rates of CAP have also been observed in the right coronary artery [2,7]. Anatomical risk factors include complex coronary lesions (as classified by ACC/AHA Type B2, C), chronic total occlusions (CTO), significantly calcified lesions, lesions that are angled or twisted, and naturally narrow coronary arteries [2,3,5,10]. The usage of hydrophilic-coated guide wires, larger-than-necessary balloons and stents, as well as high-pressure balloon inflations, have been implicated in a higher occurrence rate of CAP [3,9,10].

Given that CAP is an unwanted surgical event, the choices made regarding the surgical approach and its execution are highly influential on the patient's outcome. Perforation can occur through several mechanisms such as exiting of the guidewire, advancement of microcatheters, inflating balloons, orbital atherectomy, rotational atherectomy, and during stenting, with guidewire exit, balloon inflation, and stenting cited as the most common causes of perforation, particularly the exit of the guidewire [1,2,4,5,7,10].

Complications

Pericardial effusion and lowered blood pressure are frequent complications arising from coronary artery perforations [5]. Other serious outcomes can include sudden cardiac arrest, ventricular fibrillation, cerebrovascular accidents, major vessel closure, tamponade, various arrhythmias, heart attacks, cardiogenic shock, and, in the most severe scenarios, fatality [1-3,8].

Additionally, stent thrombosis has emerged as a complication in cases where CAP was managed with coated stents. While the literature is sparse on this topic, evidence suggests thrombosis could occur in approximately 8.6% of patients within three years of the procedure. The incidence of acute stent thrombosis seems to be higher in patients treated with covered stents compared to those who underwent alternative treatments [2]. To mitigate the risk of delayed endothelium recovery and thrombus development, extended treatment with dual antiplatelet medication is recommended [10].

An analysis by Hendry et al. identified that the insertion of a pericardial drain and the urgency of procedures were linked most strongly to mortality following perforation. Notably, deaths did not occur directly from continued bleeding due to an unfixed perforation; the more common cause was cardiogenic shock prompted by sudden blockage of the involved vessel [5].

Classification

Coronary artery perforation (CAP) is stratified by both its position within the coronary system and the extent of injury [1]. The categorization scheme introduced by Ellis and colleagues in 1994 remains the benchmark for assessing the severity of CAP.

The classification, based on the findings from coronary angiography, distinguishes the following types [8]:

Type I - Identified by an extraluminal depression without any leakage of contrast material.

Type II - Characterized by the presence of staining within the myocardium or pericardium, which does not include any rupture that is 1mm or more in diameter.

Type III - A clear rupture at least 1mm in diameter, accompanied by the outflow of contrast agent.

Type III-CS - A Type III rupture with the added feature of contrast flowing directly into a cardiac chamber or the coronary sinus [3].

Diagnostics

Coronary Artery Perforations (CAPs) are typically identified through real-time coronary angiography during percutaneous coronary intervention (PCI) [3,9]. However, less obvious CAPs may be overlooked, making it crucial to consider this diagnosis in patients who suddenly experience shortness of breath, low blood pressure, unaccountable rapid heartbeat, or recurrent or sustained chest pain after PCI [3,9].

In patients exhibiting these symptoms, which suggest hemodynamic instability, and particularly in those with confirmed or suspected pericardial effusion, serial echocardiography becomes an essential diagnostic tool to track any changes [7, 9]. Clinical suspicion of myocardial perforation and the resulting accumulation of fluid should be high during catheterization, especially if the patient reports chest discomfort or related symptoms [11]. Given the life-threatening nature of cardiac tamponade, transthoracic echocardiography is advised without delay when tamponade is suspected [10, 11]. Prompt recognition of pericardial effusion and tamponade is crucial for improving patient survival and outcomes.

Modalities of Management

The objective in treating Coronary Artery Perforation (CAP) centers on swiftly stabilizing the patient's hemodynamics and sealing the site of the perforation to restore optimal blood flow, aiming for a TIMI grade 3 result [3,5]. For Ellis type I and II CAPs, treatment is often conservative, primarily using prolonged balloon inflation [2,4]. However, the treatment for Type III perforations, particularly those involving smaller distal vessels, demands a more individualized strategy [1].

Currently, there is no consensus on a standardized treatment protocol for CAP, making the management dependent on the immediacy of the patient's condition and the available therapeutic options.

Central to the treatment is the stabilization of blood circulation and managing any low blood pressure. A range of interventions are available for this purpose, including:
- Administration of intravenous fluids and vasopressors, and support from circulatory assistance devices like intra-aortic balloon pumps [3,12].
- Temporary suspension of platelet aggregation inhibitors and anticoagulants, optimally post equipment removal to minimize the risk of blood vessel clotting [1].
- Infusion of protamine to reverse anticoagulation, although its use has become more selective due to potential exacerbation of coronary clots [5,7].
- Platelet transfusions, particularly if glycoprotein IIb/IIIa inhibitors have been used [3,4,10].
- Proximal balloon inflation at a low pressure, initiated right after a perforation is detected in the angiography. This process, which positions the balloon at the perforation site and inflates it for a minimum of 10 minutes, aims to curb blood loss and provide time to evaluate the severity. If needed, inflation can be repeated every 5 to 10 minutes until the perforation closes or ischemia sets in [1-4,9,10,12].

For Ellis type III perforations, specific measures are adopted:
- Covered stents, often PTFE-coated, to seal the perforation and prevent blood leakage, are typically used for larger proximal effusions or damage caused by aggressive intervention methods [3,4]. Although effective, challenges in delivery due to size and compatibility issues with guide catheters have been noted [5].
- Metallic coils delivered through guide wires or microcatheters, which capitalize on their thrombogenic properties to seal perforations, are frequently used for smaller distal vessels [3,4].
- Microspheres that are hydrophilic and non-absorbable, delivered precisely to the perforation site via microcatheters, are another approach for smaller distal perforations [3,4].
- Autologous blood clots and fat embolization, leveraging their universal availability and compatibility with the body, create a physical barrier against blood loss and are often used in smaller, distal perforations [3,4,7,9,10].
- Thrombin injections, serving as potent activators for platelets, aid in forming fibrin clots and are applied in smaller, distal perforations [4,7,9,10].
- Surgical repair, a last resort when less invasive methods are inadequate or have failed, or when pericardiocentesis does not relieve the condition. Surgical options may include suturing the vessel or performing coronary bypass grafting [3,10].

Urgent pericardiocentesis is essential when tamponade, a serious complication of CAP, occurs. Rapid intervention to evacuate the pericardial effusion can be lifesaving [3,4,12]. This procedure, coupled with supportive measures like intravenous fluid therapy and inotropic agents, should be initiated as soon as hemodynamic instability is detected [5]. Reinfusing the aspirated pericardial blood can improve the outcome and potentially reduce the need for blood transfusion [12]. Even with the presence of covered stents, pericardiocentesis may still be necessary, underscoring the critical need for early detection of tamponade for patient survival [4].

Prognosis

The prognosis following a coronary artery perforation (CAP) greatly depends on the perforation's classification according to the Ellis scale. Additional factors, such as the occurrence of major arterial blockage and complications with covered stents, like thrombosis, are also critical in forecasting patient outcomes [2].

Patients with Type I perforations usually have a favorable prognosis. These cases often resolve without intervention or result in mild pseudoaneurysm formation [5]. Type II perforations may self-correct as well, though they carry a higher potential for developing pseudoaneurysms and progressing to more serious conditions such as tamponade. The mortality associated with Ellis class I and II perforations stand at an average of 0% and 1.7% respectively [2].

On the other hand, Type III perforations—which can occur due to the use of balloons, stents, or other intracoronary instruments—frequently cause tamponade that demands pericardial drainage [3,10]. These cases are linked with a marked increase in mortality and often require emergent coronary artery bypass graft surgery to rectify the issue [3-5,12,14]. Reports cite a procedural mortality rate that ranges from 14.8% to 21% [5,7].

Conclusion

In conclusion, this case exemplifies the critical challenges and innovative solutions necessary in managing complex coronary interventions like Coronary Artery Perforation (CAP) under resource-limited conditions. The successful use of prolonged manual balloon inflation and deflation to stabilize an Ellis class 3 perforation in the LAD artery demonstrates an effective interim measure while awaiting the covered stent. This approach highlights the importance of adaptability and resourcefulness in acute cardiac emergencies. Overall, this report contributes to the broader dialogue on optimizing CAP management strategies in varied healthcare environments, encouraging ongoing innovation in the field of interventional cardiology

Declaration

Ethics Approval and Consent to Participate: All procedures were conducted following the ethical standards outlined in the Declaration of Helsinki. Informed consent was obtained from all participants included in the study.

Patient Perspective: I was terrified when I found out that my heart condition had gotten worse and needed treatment. The medical team at Mellat Medical Institute cared for me well and professionally. Even though they had limited resources, they worked hard to stabilize my condition. I can still remember the relief I felt when I woke up and was told that my surgery was successful. The team kept me updated every step of the way, and their commitment comforted me during a difficult time. Looking back, I am incredibly grateful for their expertise and care, which ultimately saved my life.

Consent for Publication: Written informed consent was obtained from the patient for publication of this case report and any accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

Availability of Data and Material: The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request. Materials used in the study are also available upon request.

Competing Interests: The authors declare that they have no competing interests.

Authors' Contributions: A.Q.N., N.A.J., A.Z., S.S.S. and A.J.R. contributed to the conceptualization of the study. A.Q.N., S.S.S. and A.J.R. conducted the investigation. N.A.J. and A.Z. contributed to data curation. A.Q.N., S.S.S. and A.J.R. wrote the original draft.

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References

1. Avula V, Karacsonyi J, Kostantinis S, et al. Incidence, Treatment, and Outcomes of Coronary Artery Perforation During Percutaneous Coronary Intervention. J Invasive Cardiol, 2022; 34(7): E499-E504.
2. Ford TJ, Adamson C, Morrow AJ, et al. Coronary Artery Perforations: Glasgow Natural History Study of Covered Stent Coronary Interventions (GNOCCI) Study. J Am Heart Assoc, 2022; 11(19): e024492. doi:10.1161/JAHA.121.024492.
3. Nagalli S, Hajouli S. Coronary Artery Perforation, 2023.
4. Lemmert ME, van Bommel RJ, Diletti R, et al. Clinical Characteristics and Management of Coronary Artery Perforations: A Single-Center 11-Year Experience and Practical Overview. J Am Heart Assoc, 2017; 6(9): e007049.
5. Hendry C, Fraser D, Eichhofer J, et al. Coronary perforation in the drug-eluting stent era: incidence, risk factors, management and outcome: the UK experience. EuroIntervention. doi: 10.4244/EIJV8I1A13.
6. Mikhail P, Howden N, Monjur M, et al. Coronary perforation incidence, outcomes and temporal trends (COPIT): a systematic review and meta-analysis. Open Heart, 2022; 9(2): e002076. doi:10.1136/openhrt-2022-002076.
7. Lemmert ME, van Bommel RJ, Diletti R, et al. Clinical Characteristics and Management of Coronary Artery Perforations: A Single-Center 11-Year Experience and Practical Overview, 2017.
8. Ellis SG, Ajluni S, Arnold AZ, et al. Increased coronary perforation in the new device era. Incidence, classification, management, and outcome. Circulation, 1994; 90(6): 2725-2730. doi: 10.1161/01.cir.90.6.2725.
9. Paul TK, Lata K, Brilakis ES. Management of Distal Coronary Artery Perforation, 2022.
10. Al-Mukhaini M, Panduranga P, Sulaiman K, et al. Coronary perforation and covered stents: an update and review. Heart Views, 2011; 12(2): 63-70. doi:10.4103/1995-705X.86017.
11. Holmes DR, Nishimura R, Fountain R, Turi ZG. Iatrogenic Pericardial Effusion and Tamponade in the Percutaneous Intracardiac Intervention Era. JACC: Cardiovascular Interventions, 2009; 2(8): 705-717. doi: 10.1016/j.jcin.2009.04.019.
12. Abdalwahab A, Farag M, Brilakis ES, Galassi AR, Egred M. Management of Coronary Artery Perforation. Cardiovasc Revasc Med, 2021; 26: 55-60. doi: 10.1016/j.carrev.2020.11.013.
13. Silva WA, Costa RA, Campostrini T, et al. Incidence, Management and Prognosis of Coronary Perforations. Rev Bras Cardiol Invasiva (English Edition), 2012; 20(3): 295-302. doi: 10.1016/S2214-1235(15)30068-5.
14. Kostantinis S, Simsek B, Karacsonyi J, et al. Incidence, Mechanisms, Treatment, and Outcomes of Coronary Artery Perforation During Chronic Total Occlusion Percutaneous Coronary Intervention. Am J Cardiol, 2022; 182: 17-24. doi: 10.1016/j.amjcard.2022.07.004.