Case Report

Endovascular Management of a Shotgun Pellet Injury with a Compressive Effect on the Right Coronary Artery: A Case Report

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Highlights

- Diagnostic Value of IVUS: Demonstrates for the first time the definitive role of intravascular ultrasound (IVUS) in distinguishing extrinsic compression (intact vessel wall, hourglass lumen) from intrinsic coronary pathology (e.g., dissection, thrombosis) in the setting of a metallic foreign body.
- Minimally Invasive Alternative: Shows that percutaneous intervention with a new-generation covered stent (BeGraft) is a safe and effective alternative to high-risk redo cardiac surgery for pellet removal in a previously operated field.
- Overcoming Artifact Limitations: Highlights that coronary CT angiography (CCTA) was non-diagnostic due to severe metallic "blooming" artifact, underscoring the continued necessity of invasive angiography and IVUS in such trauma patients.
- Key Technical Decision: The choice of a covered stent (rather than a drug-eluting stent) was critical to prevent coronary perforation from the adjacent pellet, addressing the compressive lesion while leaving the deep-seated foreign body in situ.
- Long-Term Risk Awareness: Emphasizes the need for structured long-term follow-up due to ongoing risks of the retained pellet, including late erosion, migration, infection, and thromboembolism.

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ABSTRACT

Background: Delayed coronary artery compression because of a retained epicardial shotgun pellet is an exceptionally rare complication of penetrating cardiac trauma. Its optimal diagnosis and management are not well established.

Case Presentation: We describe a 40-year-old man who presented with new-onset exertional chest pain 4 months after sustaining a shotgun pellet injury to the chest. The initial injury was managed with an emergency thoracotomy for hemopericardium and pulmonary repair, during which several epicardial pellets were left in situ. At our center, examination revealed inferior wall hypokinesia on ultrasonography. Coronary angiography demonstrated high-grade stenosis of the mid-right coronary artery caused by external compression from an adjacent retained pellet. Intravascular ultrasound (IVUS) confirmed extrinsic compression with an intact vessel wall. The patient was successfully treated with percutaneous implantation of a new-generation covered stent, resulting in immediate symptom relief and restoration of Thrombolysis in Myocardial Infarction (TIMI) grade 3 flow.

Conclusion: This case highlights a rare mechanism of delayed posttraumatic myocardial ischemia and demonstrates that percutaneous endovascular stenting with a covered stent is a safe and effective minimally invasive alternative to high-risk redo surgery in selected patients. The use of IVUS was crucial in confirming the diagnosis and guiding the therapeutic strategy.

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Introduction

Penetrating cardiac traumas are rare and associated with high mortality rates. Although the acute management of hemodynamic instability or active bleeding is well described, the delayed complications of retained intracardiac or epicardial foreign bodies are less frequently encountered and pose unique diagnostic and therapeutic challenges.[1] These complications can include late erosion, fistula formation, embolism, infective endocarditis, and, as in this case, external compression of a coronary artery leading to myocardial ischemia.[2] The optimal management strategy for such delayed presentations—whether medical therapy, redo surgery, or percutaneous intervention—remains unclear because of the paucity of reported cases.

Here, we present a unique case of delayed right coronary artery (RCA) compression by a retained shotgun pellet, successfully managed with an endovascular approach guided by intravascular ultrasound (IVUS), a diagnostic modality not previously documented for this specific pathology.

Case Report

Initial Presentation and Emergency Management (4 Months Prior)

In October 2022, a 40-year-old man with no prior cardiac history sustained multiple penetrating wounds from a shotgun blast to the left chest. He was immediately transferred to a general hospital. Upon arrival, he was hemodynamically unstable with tachycardia and hypotension. Because of this instability and clinical suspicion of cardiac tamponade, he was taken emergently for surgery without preoperative cross-sectional imaging. An emergency left thoracotomy was performed, which revealed a massive hemothorax and hemopericardium from a laceration to the lower lobe of the left lung. A pericardial window and repair of the lung laceration were performed. Multiple shotgun pellets were noted to be embedded in the epicardial surface overlying the right ventricle and the atrioventricular groove; nonetheless, they were left untouched because of their small size and deep, precarious location to avoid further myocardial injury. The postoperative course was uneventful, and he was discharged after 2 weeks in good general condition. An electrocardiogram (ECG) from that admission showed normal sinus rhythm with no ischemic changes or pathologic Q waves (Figure 1).

Presentation to Our Center (4 Months Later)

In February 2023, the patient presented to our cardiology clinic with a 1-month history of progressive exertional chest pain (Canadian Cardiovascular Society class II-III), which was relieved by rest. He denied any rest pain or dyspnea. On physical examination, vital signs were stable (blood pressure: 110/60 mm Hg; pulse: 80 beats/min; respiratory rate: 18/min). Cardiovascular examination was unremarkable. Laboratory tests, including high-sensitivity troponin I, were within normal limits. A 12-lead ECG (Figure 2) showed normal sinus rhythm; nevertheless, closer inspection revealed subtle but definite pathologic Q waves and shallow T-wave inversions in the inferior leads (II, III, and aVF), suggestive of an old inferior injury. A chest radiograph revealed multiple small metallic densities over the cardiac silhouette, consistent with the known retained pellets, but was otherwise normal with clear lung fields. Fluoroscopy showed small metallic densities (Figure 3). Transthoracic echocardiography demonstrated hypokinesia of the inferior and basal septal walls, with a left ventricular ejection fraction of 45%. There was no pericardial effusion. Coronary computed tomography angiography (CCTA) was attempted to evaluate the coronary arteries, but the midsegment of the RCA was completely nonevaluable because of severe metallic "blooming" artifact from an adjacent pellet.

On account of the ongoing symptoms, wall motion abnormality, and inconclusive CCTA, invasive coronary angiography was pursued.

Coronary Angiography and Intervention

Coronary angiography revealed high-grade, eccentric stenosis (approximately 90%) in the midportion of the RCA, corresponding exactly to the location of a large epicardial pellet seen on fluoroscopy. The stenosis caused Thrombolysis in Myocardial Infarction (TIMI) flow grade 1 distally

(Figure 4A). The left coronary artery system was normal. Given the recent thoracotomy and the high risk of redo cardiac surgery for pellet extraction, a percutaneous approach was chosen. IVUS was performed to better characterize the lesion. IVUS confirmed the presence of a rounded, echogenic structure (the pellet) external to the vessel wall, causing severe, smooth, hourglass-shaped compression of the true lumen (Figure 5). Importantly, the 3-layered structure of the arterial wall appeared intact, with no evidence of intimal flap, dissection, or intramural hematoma.

Based on the IVUS finding of an intact vessel wall and the proximity of the pellet, the decision was made to proceed with percutaneous intervention. Concern for vessel perforation during high-pressure balloon inflation prompted the selection of a new-generation, single-layer polytetrafluoroethylene (PTFE)–covered coronary stent (a 3 × 24 mm BeGraft stent). The stent was successfully deployed at 14 atm, covering the compressed segment. Final angiography demonstrated excellent expansion with only mild residual stenosis (<10%) and restoration of TIMI grade 3 flow distally (Figure 4B). A final IVUS run confirmed good stent apposition and excluded any perforation. The pellet was left in situ, as it was deeply embedded, and the compressive effect was successfully addressed. The patient remained asymptomatic and was discharged on dual antiplatelet therapy (aspirin and clopidogrel) the following day.

Follow-up

At the 1-month follow-up, the patient underwent repeat angiography for atypical chest pain, which revealed TIMI grade 3 flow in the RCA. He remained completely asymptomatic at the 6-month follow-up.

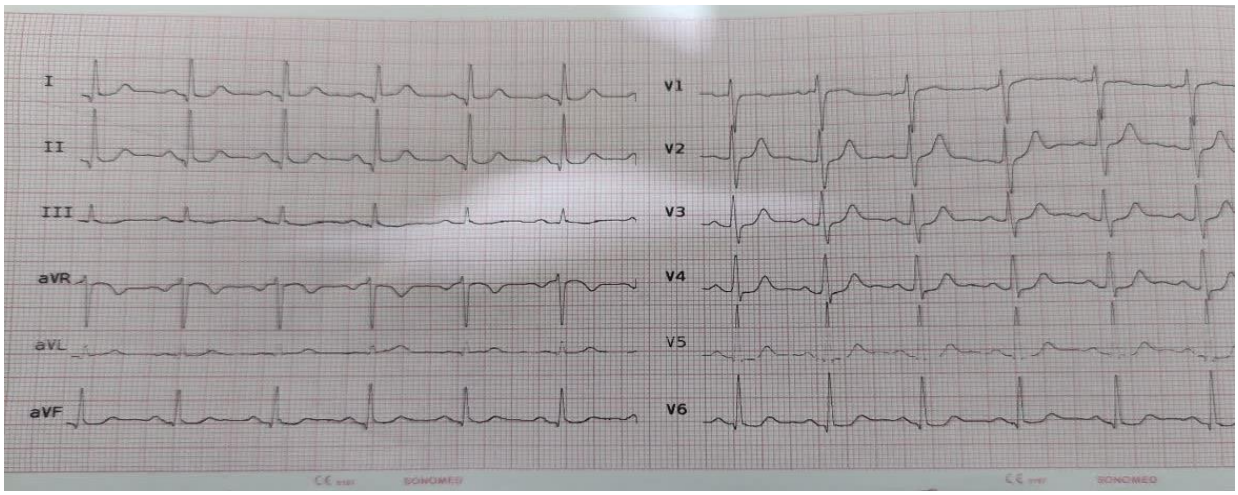

Figure 1. A normal 12-lead ECG on admission shows sinus rhythm with no evidence of ischemia or pathologic Q waves.

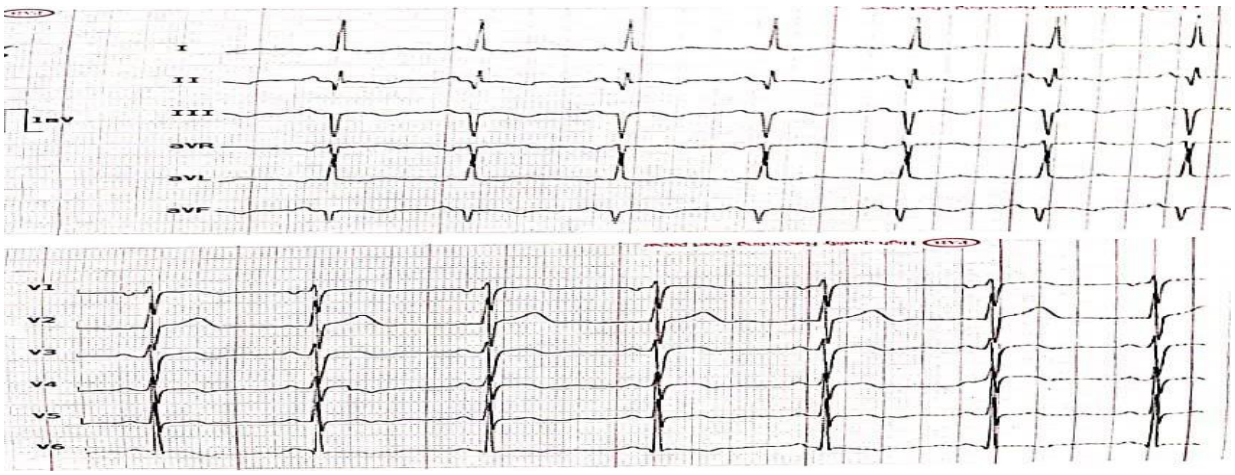

Figure 2. A 12-lead electrocardiogram 4 months postinjury demonstrates normal sinus rhythm. Pathologic Q waves and subtle T-wave inversions are present in the inferior leads **(**II, III, and aVF), suggesting an old inferior infarction.

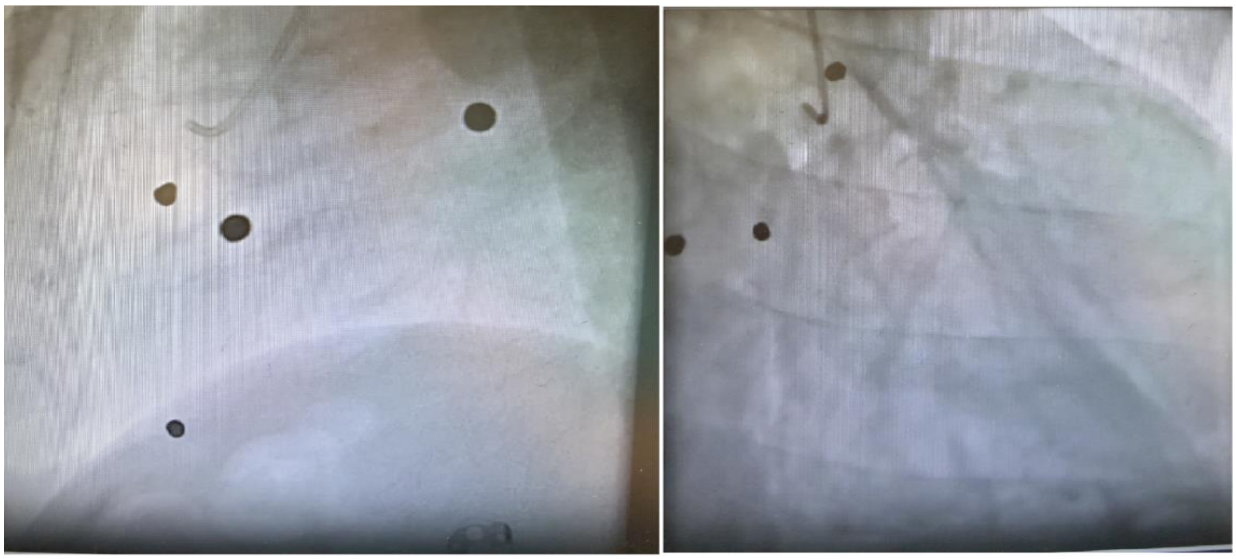

Figure 3. Fluoroscopy shows metallic pellets in the lung field.

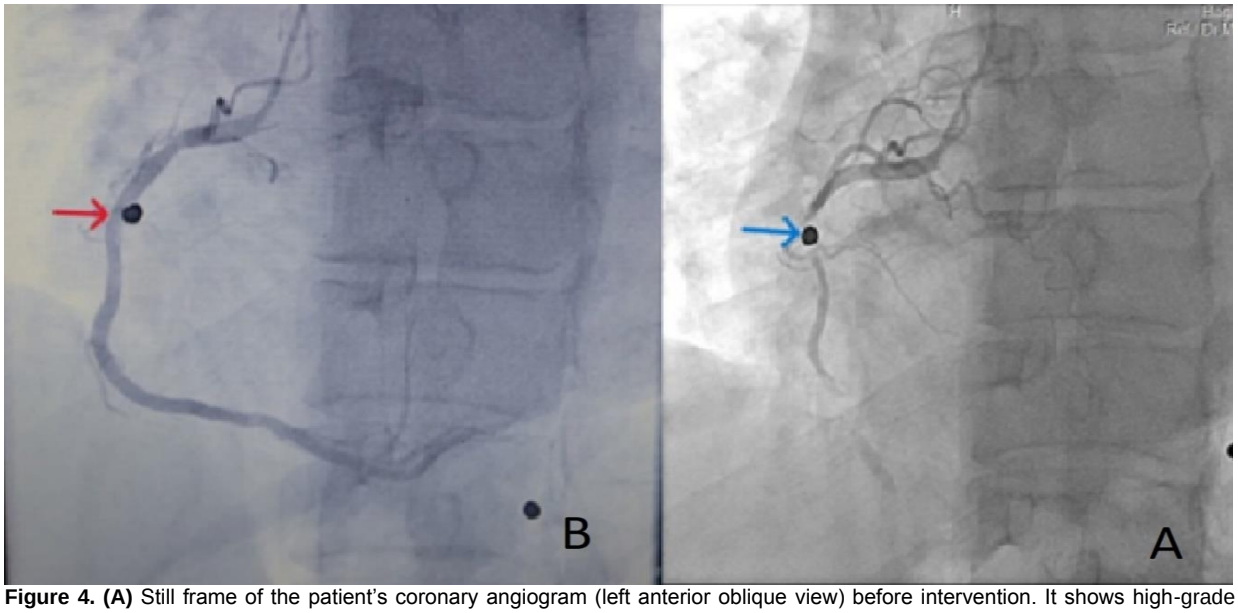

Figure 4. (A) Still frame of the patient's coronary angiogram (left anterior oblique view) before intervention. It shows high-grade stenosis (blue arrow) of the mid-right coronary artery because of external compression from an adjacent pellet (not visible), with Thrombolysis in Myocardial Infarction (TIMI) grade 1 flow distally. **(B)** Angiogram after implantation of a 3.5 × 18 mm BeGraft covered stent. The stenosis is resolved, and TIMI grade 3 flow is restored (red arrow).

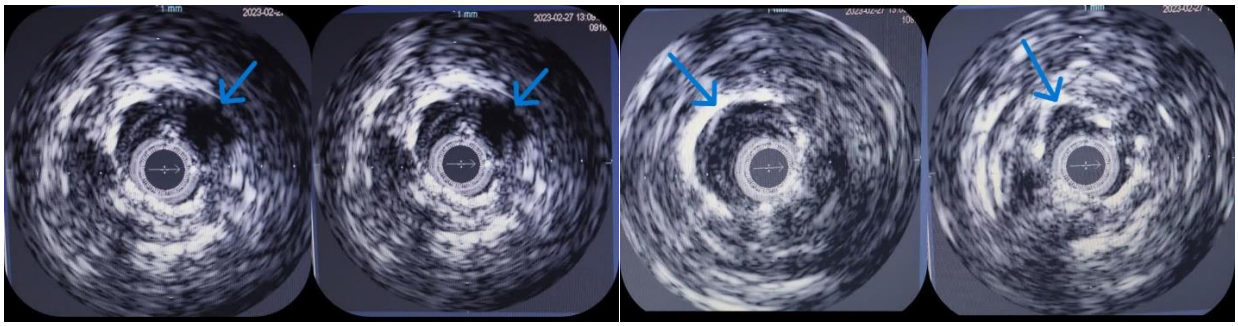

Figure 5. Intravascular ultrasound (IVUS) image from the mid-right coronary artery demonstrates a rounded, echogenic structure (the shotgun pellet, marked by asterisks) external to the vessel wall, causing smooth, hourglass-shaped compression of the true lumen. The 3-layered structure of the arterial wall appears intact.

Discussion

This case illustrates a rare and challenging late complication of penetrating cardiac trauma: delayed myocardial ischemia because of extrinsic compression of a coronary artery by a retained epicardial foreign body. Although coronary injury from direct laceration or missile embolization is documented, external compression as a cause of progressive stenosis is exceptionally rare and, to

our knowledge, the use of IVUS to confirm this mechanism has not been previously reported.[3,4]

The clinical presentation of penetrating heart trauma is highly variable, ranging from immediate hemodynamic collapse to delayed complications months or even years later.[1,2,5] Our patient's case evolved in 2 distinct phases: an acute hemorrhagic phase managed surgically, followed by a chronic phase characterized by progressive exertional angina. The development of pathologic Q waves on ECG and inferior wall hypokinesia on echocardiography pointed to a subclinical myocardial infarction in the intervening period, likely as the compressive effect of the pellet gradually increased as a result of scarring or a subtle shift in position.

The diagnostic workup of such patients is fraught with challenges. As demonstrated in our case, CCTA is often of limited value because of extensive metallic artifact from the pellets, which can obscure critical vascular segments.[6] This pitfall underscores the continued importance of invasive coronary angiography for definitive diagnosis. More importantly, our case highlights the crucial role of IVUS. Although angiography suggested a severe stenosis, it could not distinguish between intrinsic vascular injury (eg, dissection or thrombosis) and extrinsic compression. IVUS provided the definitive answer in that it revealed a smooth, hourglass-shaped lumen with an intact vessel wall, confirming the diagnosis of pure extrinsic compression. This finding was pivotal in guiding our therapeutic strategy.

The management of retained intracardiac or epicardial pellets involves balancing the risks of removal against the potential for long-term complications.[2] Several factors influenced our decision to leave the pellet untouched and pursue an endovascular approach. Firstly, redo sternotomy or thoracotomy for pellet retrieval in a previously operated field carries significant risks, including bleeding, infection, and further myocardial damage. Secondly, the IVUS finding of an intact arterial wall suggested that addressing the luminal compromise alone, without removing the compressive agent, could be effective. Thirdly, the proximity of the pellet to the vessel wall posed a risk of coronary perforation with conventional balloon angioplasty or stenting.

This risk of perforation was the primary driver for our choice of a covered stent. Still, the type of covered stent is a critical consideration. Early-generation covered stents, often with a double-layer PTFE design, have been associated with higher rates of stent thrombosis and restenosis (up to 10%–15% in some series).[7,8] In contrast, the new-generation single-layer covered stents (eg, BeGraft, PK Papyrus) have demonstrated significantly improved safety and efficacy profiles, with lower thrombotic risk and better deliverability, making them a more attractive option in scenarios like ours.[9] The use of a BeGraft stent in this patient was intended to provide a durable solution while minimizing long-term thrombotic risk. This distinction is crucial for clinicians considering this approach. Although a drug-eluting stent might have been considered for a simple, noncompressive lesion, the high risk of perforation from the adjacent pellet in our case made a covered stent the safer, albeit more complex, choice.

Despite the successful short-term outcome, it is imperative to acknowledge the well-documented delayed complications of retained intracardiac or epicardial foreign bodies,[2,10,11] including.

1. Late erosion/migration: The pellet could theoretically erode into the adjacent coronary artery, the right atrium, or the pericardial space, potentially causing fatal hemopericardium or tamponade, even years after the injury.
2. Infection: Although rare, retained metal fragments can serve as a nidus for infective endocarditis.
3. Thromboembolism: The stent itself and the retained pellet are potential sources of thrombus.
4. Lead toxicity: Although more common with intra-articular bullets, systemic lead absorption from pellets in vascularized tissue is a theoretical long-term risk.

Therefore, a clear long-term follow-up plan is essential. Our patient will require indefinite dual antiplatelet therapy for the first year (aspirin + clopidogrel), followed by lifelong single antiplatelet therapy. We have planned for annual clinical evaluations and serial echocardiography to monitor for any changes in wall motion, pericardial effusion, or evidence of infection. A follow-up

CCTA, potentially with advanced metal artifact reduction techniques, might be considered in 2 to 3 years to assess for any change in pellet position or stent integrity, although this is not mandatory in an asymptomatic patient.

Conclusions

This case report makes several noteworthy contributions. Not only does it describe a rare mechanism of delayed posttraumatic myocardial ischemia (external coronary compression by a retained pellet), but it is also the first to demonstrate the definitive diagnostic value of IVUS in this context. Moreover, it shows that percutaneous treatment with a new-generation covered stent is a safe and effective minimally invasive alternative to high-risk redo cardiac surgery in carefully selected patients. However, the report also underscores the need for a comprehensive discussion of the long-term risks associated with retained foreign bodies and a structured follow-up plan. Clinicians managing such patients must remain vigilant for these delayed complications.

Declarations:

Ethical Approval

Informed consent was obtained from all patients and/or their legal guardians, and the novelty of the procedure was explained to all patients and their legal guardians.

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Conflict of Interest

The authors declare that there are no conflicts of interest.

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