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Case Report: Coronary Artery Bypass Graft in Emergent Operative Management of Ballistic Cardiac Trauma

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Manuscript Received: 18 December 2025
Manuscript Accepted: 29 December 2025
Date of Publication: 31 December 2025

This article is available from: https://pnwjs.org/index.php/journal/article/view/13
doi: https://doi.org/10.70422/91bjjm98

BACKGROUND: Penetrating cardiac trauma is a rare but highly lethal injury, with prehospital mortality rates exceeding 80%. Advances in trauma resuscitation, surgical intervention, and multidisciplinary collaboration have improved survival rates in select patients. Injuries to the left anterior descending (LAD) artery are particularly devastating, as disruption of coronary circulation can lead to tamponade, ischemia, cardiogenic shock, and rapid deterioration. While traditional management of penetrating coronary injuries often prioritizes hemorrhage control, emerging evidence suggests that coronary artery bypass grafting (CABG) may offer improved outcomes in appropriate candidates.

CASE PRESENTATION: We present a case report of a 32-year-old female who sustained a penetrating cardiac injury with transection of the LAD. The patient was managed at a Level I trauma center with a combined trauma and cardiac surgical approach. Relevant clinical variables, including injury severity, intraoperative decision making, operative interventions, and postoperative outcomes, are presented. The patient underwent immediate bilateral thoracotomy for hemorrhage control, with initial hemostasis achieved through LAD clipping. Intraoperative Cardiac Surgery consultation led to emergent CABG with reverse saphenous vein grafting to restore coronary circulation. The patient tolerated the procedure well, with successful weaning from cardiopulmonary bypass (CPB). Postoperative recovery was favorable, with early ambulation and discharge on postoperative day eight.

DISCUSSION: This case highlights the evolving role of CABG in penetrating cardiac trauma and underscores the importance of rapid intervention and multidisciplinary collaboration.

CONCLUSION: In select cases of penetrating cardiac injury, aggressive surgical management, including coronary revascularization, may offer improved survival and functional outcomes.

Keywords: *Ballistic Cardiac Trauma, Cardiac Surgery, Cardiac Trauma, Cardiopulmonary Bypass, Case Report, Coronary Artery Bypass, Coronary Artery Bypass Graft, CABG, Gunshot Wound, GSW, Thoracic Trauma, Trauma Surgery, Resuscitative Thoracotomy.*

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DISCLAIMER

Information published in this article is not intended to replace clinical judgement or establish a protocol for the care of patients with penetrating cardiac trauma. The treatment included in this article is not intended as the sole source of guidance in the management of penetrating cardiac trauma, and may not provide the only acceptable approach to the management of this condition. The views expressed in this article are solely those of the authors and do not reflect the views of The Pacific Northwest Journal of Surgery or its Editorial Board.

BACKGROUND

Penetrating cardiac trauma is a rare but highly lethal injury, with mortality rates exceeding 80% in prehospital settings.[1] Advances in prehospital care, early surgical intervention, and multidisciplinary trauma and cardiac-surgical collaboration have improved survival rates for select patients who reach definitive care.[2] Firearm-related cardiac injuries present a unique challenge, as they can cause direct myocardial injury, cardiac chamber perforation, disruption of coronary circulation, rapid exsanguination, and rapid hemodynamic deterioration.[3] Management requires swift assessment of necessity for cardiopulmonary bypass (CPB), damage-control resuscitation, and prompt risk-benefit analysis to determine the best way to restore hemostasis and cardiac function.[1,3]

The left anterior descending (LAD) artery is the most critical coronary artery supplying the anterior and anterolateral walls and the interventricular septum of the heart. Injuries to this artery can lead to profound ischemia, cardiogenic shock, and high likelihood of mortality.[4] Historically, penetrating cardiac injuries involving the LAD were managed primarily with damage control techniques aimed at immediate hemorrhage control,[5-7] with definitive repair often being secondary or even unfeasible in unstable patients. However, the role of emergent coronary artery bypass grafting (CABG) for traumatic coronary injuries is evolving, particularly as advanced cardiac surgical techniques and extracorporeal support options have become more accessible in trauma centers.[5,7,8]

The integration of Trauma Surgery and Cardiac Surgery teams are crucial in cases where penetrating injuries involve major coronary arteries, necessitating immediate vascular reconstruction to restore myocardial perfusion.[2] Trauma surgeons are well-versed in initial patient stabilization and hemorrhage control. However, involvement of the Cardiac Surgery team is needed for conditions that require coronary artery bypass, cardiac structure reconstruction, or valvular repair, which often requires cardiopulmonary bypass and cardioplegia.[8] Transition to Cardiac Anesthesia support is ideal for such situations for complex management of hemodynamics and CPB.

This case illustrates the effective management of a penetrating cardiac injury with transection of the LAD, necessitating trauma surgery for initial hemorrhage control, as well as emergent cardiac surgical intervention for revascularization. It emphasizes the importance of early recognition of coronary injury, immediate surgical intervention, and the expanding role of CABG in penetrating trauma. This case contributes to the growing body of evidence that with timely intervention, even patients with severe penetrating cardiac injuries may achieve favorable outcomes, challenging traditional views of non-survivability in these cases.

Written consent for de-identified publication in the Pacific Northwest Journal of Surgery was provided by the patient. This case was reviewed by the local Institutional Review Board, and was determined not to be human subject research (IRB# 29605).

CASE PRESENTATION

A 32-year-old female presented by ambulance with a single ballistic injury to the anterior chest to our Level I trauma center. Prehospital treatment included left chest needle decompression and two grams of tranexamic acid. On arrival, she had a Glasgow Coma Score (GCS) of 9, spontaneous breathing through a patent airway, diminished left-sided breath sounds, faintly palpable pulses in all extremities, hypotension, and ballistic injuries visible to the anterior chest. Bilateral chest thoracostomy tubes were placed with the return of 600 milliliters of blood on the left and transient improvement in hemodynamics. Bedside transthoracic echocardiogram (TTE) demonstrated a small pericardial effusion. Chest radiography demonstrated a left hemothorax with ballistic fragments visible in the left lateral chest wall and a fractured left 6th rib. Hypotensive resuscitation with whole blood transfusion was initiated. Due to concern for penetrating cardiac injury, she was taken to the operating room with the Trauma Surgery team for a planned pericardial window and possible median sternotomy.

Simultaneously with induction of general anesthesia and endotracheal intubation, a subxiphoid pericardial window procedure was begun but immediate cardiac arrest ensued. The decision was made to transition to left anterolateral thoracotomy. Upon entry to the chest, a large volume of blood was evacuated, and brisk bleeding was seen from a traumatic pericardiotomy just anterior to the left phrenic nerve. The trauma pericardiotomy was extended cephalad and caudad to deliver the heart and spontaneous cardiac activity returned, with sudden and brisk arterial bleeding that was difficult to visualize through the left chest. The incision was immediately extended into a bilateral thoracosternotomy. A ballistic cardiac injury was seen traversing the anterolateral surface of the heart with clear transection of the mid LAD artery and superficial myocardial injury to the left ventricle (**Figure 1A**). The proximal LAD was briskly bleeding, first controlled with direct pressure, ultimately, due to its brisk blood flow, the distal end of the proximal half of the transected LAD was clipped to prevent exsanguination. The bilateral internal mammary arteries were ligated bilaterally in the creation of the clamshell bilateral anterolateral thoracotomy incision.

Cardiac Surgery was consulted intraoperatively upon discovery of the transected LAD artery. Given the relatively short downtime of the myocardium (approximately 3 hours from ballistic injury to coronary artery bypass), the absence of substantial concomitant bleeding injury (which would be prohibitive for systemic heparinization for CPB), and the high likelihood of good technical result given the absence of other evident cardiac comorbidities, the Cardiac Surgery team mobilized for coronary artery bypass grafting (CABG). While the cardiac surgery team was preparing, the Trauma Surgery team proceeded with pulmonary tractotomy and stapled wedge resection of the missile injury to the left upper lobe, and primary repair of the left lower lobe injury. The operative field was assessed and the relatively low clamshell incision performed by Trauma Surgery was not sufficient to accommodate an urgent CABG, including a proximal aortic vein anastomosis, which prompted additional extension of the incision with midline sternotomy. Transesophageal echocardiogram (TEE) revealed apical akinesis and a left ventricular ejection fraction (LVEF) of 30-35%. Endovascular greater saphenous vein harvest was performed. The patient was systemically heparinized for an activated clotting time

(ACT) over 480, and the patient was placed on CPB. The heart was arrested with Del Nido cardioplegia solution. The distal end of the proximal LAD had been surgically clipped, and the remaining stump of a branching diagonal artery was also clipped. The reversed saphenous vein was anastomosed to the distal segment of the LAD (**Figure 1B**). Given the diminutive size of the transected diagonal artery, the decision was made not to bypass it, as it was believed unlikely to support a hemodynamically significant graft. The patient was weaned from CPB, and the clamshell and sternotomy incisions were closed with stainless steel wires. Post-operative TEE revealed unchanged reduced left ventricular function and LVEF of 30-35%. The patient then received standard postoperative CABG care.

Postoperatively, the patient recovered well. She was extubated on postoperative day one. Heart Failure Cardiology was consulted for medical optimization and long-term follow-up of her reduced LVEF. By postoperative day three, the patient was ambulating and was downgraded to intermediate care status. On postoperative day seven, TTE showed an akinetic anterior septum and apex, and a modestly improved LVEF of 35 to 40%. A direct oral anticoagulant was initiated for the left ventricular thrombus, and guideline-directed medical therapy (GDMT) for her reduced LVEF. She was discharged on postoperative day eight. At two-month follow-up, the patient was overall doing well and denied any cardiopulmonary symptoms. Electrocardiogram demonstrated an old anterior infarct, and chest radiography demonstrated a persistently elevated left hemidiaphragm. The patient remains alive one year post-operatively.

DISCUSSION

This case demonstrates successful management of penetrating cardiac injury involving the LAD, highlighting the critical role of timely surgical intervention and multidisciplinary collaboration between Trauma Surgery and Cardiac Surgery teams. The rarity and severity of such injuries, coupled with historically high mortality rates,[2] make this case an important contribution to the growing body of literature advocating for aggressive surgical management in select patients who arrive at a trauma center with signs of life. These injuries are likely underreported, and this report one of few found on the topic, especially in recent literature.[9] The patient's survival and favorable postoperative outcome demonstrates the potential for improved survival in penetrating cardiac trauma when trauma systems work in concert and underscore the importance of evolving surgical strategies in trauma care.

Historically, penetrating cardiac injuries have been associated with very poor outcomes, particularly when major coronary arteries are involved.[10] In this case, the patient underwent rapid thoracotomy after arrival to the operating room, allowing for direct control of ongoing pericardial bleeding. While traditional trauma management often involves the ligation of damaged coronary arteries in the context of life-threatening bleeding,[8,11] trauma centers with immediate access to Cardiac Surgery services have created the possibility of emergent complex coronary revascularization, offering improved long-term cardiac function and survival in appropriate patients.

A key aspect of this case was the intraoperative decision-making process. The Trauma Surgery team effectively implemented damage control measures, including the placement of a hemostatic clip on the transected LAD. However, ongoing hemodynamic instability required a multidisciplinary approach, leading to intraoperative consultation with Cardiac Surgery. This underscores the critical need for trauma surgeons to recognize when definitive repair exceeds their expertise, and to swiftly mobilize specialized surgical teams. In this instance, the decision to proceed with emergency CABG was crucial in restoring coronary circulation and preventing

Figure 1

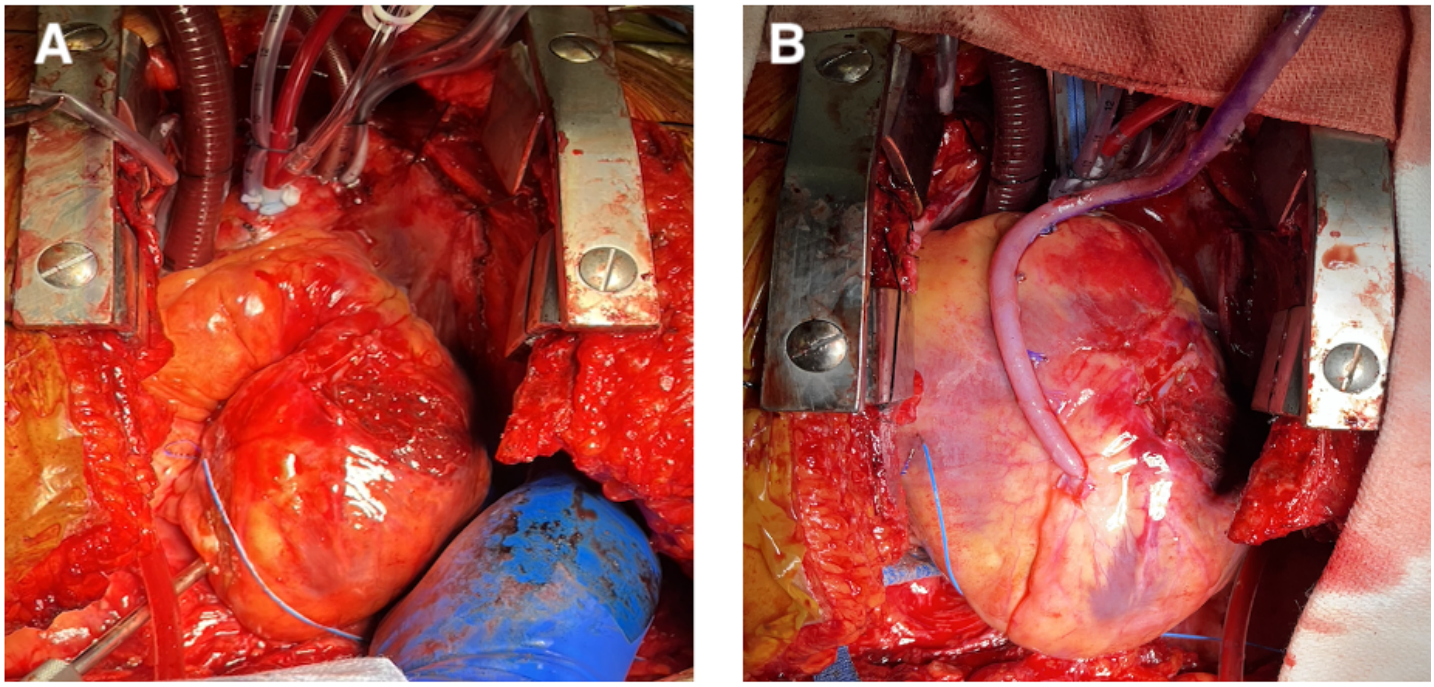

Figure 1. A. Intra-operative photograph of a gunshot wound avulsion of the anterior surface of heart. **B.** Appearance of heart after reverse saphenous vein graft to left anterior descending (LAD) artery. (Aortic proximal anastomosis not pictured.)

further ischemic damage. While CABG in the trauma setting is rare, recent reports indicate it may be a viable option for patients with isolated coronary artery injuries, especially younger individuals with otherwise normal cardiac anatomy.[12]

Another consideration in this case was the intraoperative transition from a damage control approach to definitive repair. This case illustrates the importance of surgical adaptability in penetrating cardiac trauma, as standard trauma thoracotomy exposures may not always be optimal for complex cardiac repairs. The use of CPB further exemplifies how advanced surgical techniques can be successfully integrated into trauma surgery to improve patient outcomes.

The postoperative course for this patient followed a typical trajectory for patients recovering from myocardial infarction. The patient developed apical akinesis secondary to myocardial infarction of the distal LAD territory. Though myocardium was infarcted, rapid LAD bypass was necessary to prevent further life-threatening myocardial ischemia. Left ventricular thrombus is a common complication of a territory of akinetic myocardium, and this is a recognized complication following myocardial infarction, particularly in the setting of LAD injury. This underscores the importance of close cardiac follow-up in patients who survive penetrating cardiac trauma with coronary involvement. Despite this complication, the patient's overall recovery was favorable, with early ambulation, weaning from mechanical ventilation, and discharge eight days after the initial injury. The relatively short hospital stay further emphasizes the potential benefits of aggressive surgical intervention in well-selected patients. The patient's long-term cardiac prognosis is favorable, with the role of modern GDMT improving long-term quality of life and survival in cardiac patients.[13]

This case adds to the growing recognition that penetrating cardiac injuries involving coronary arteries should not be considered universally fatal. With rapid prehospital transport, immediate hemorrhage control, and the availability of advanced cardiac surgical techniques, some patients may achieve meaningful long-term survival with preserved cardiac function. Identifying criteria for emergent CABG versus traditional damage control techniques will be essential in optimizing outcomes for these critically injured patients. In this arena, this type of coordination is vital for patient survival, and as rare as these cases are and underrepresented in the literature, this case serves as a critical reminder of a rare but lethal event that can only be managed by timely diagnosis and excellent multidisciplinary trauma care.

CONCLUSION

Penetrating injuries involving the coronary arteries remain highly lethal. In patients who arrive at definitive care, outcomes depend on rapid hemorrhage control, early recognition of coronary artery injury, and timely escalation of care. This case emphasizes the importance of intraoperative decision-making and early multidisciplinary collaboration when a major coronary vessel is involved. In select patients, emergent coronary artery bypass grafting should be considered as a definitive strategy to restore myocardial perfusion and limit ongoing ischemic injury. Trauma surgeons must recognize when damage control alone is insufficient and promptly involve Cardiac Surgery when coronary revascularization may meaningfully improve survival and long-term cardiac function.

Patient Consent: Written informed consent was obtained from the patient by the authors for publication of this case report and images in The Pacific Northwest Journal of Surgery. Identifying personal information has been removed. A copy of the written consent is retained by the Journal.

Competing Interests: The authors attest to having no financial or commercial associations that may create conflicts of interest with the information presented in the manuscript.

Authors' Contributions: All authors provided substantial contributions to the conception of the work or interpretation of data for the work; were involved in drafting the work or revising it; gave final approval of the version to be published; and were in agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Funding Information: There was no funding associated with this publication.

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Abbreviations: Activated clotting time (ACT), Cardiopulmonary bypass (CPB), Coronary artery bypass graft (CABG), Glasgow Coma Score (GCS), Guideline-directed medical therapy (GDMT), Left anterior descending (LAD), Left ventricular ejection fraction (LVEF), Transthoracic echocardiogram (TTE)

REFERENCES

1. O'Connor J, Ditillo M, Scalea T. Penetrating cardiac injury. J R Army Med Corps. 2009 Sep;155(3):185-90. doi: 10.1136/jramc-155-03-02
2. Embrey R. Cardiac trauma. Thorac Surg Clin. 2007 Feb;17(1):87-93, vii. doi: 10.1016/j.thorsurg.2007.02.002
3. Adigopula S, Medepalli LC. Gunshot-Related Cardiac Trauma: A Multidisciplinary Approach Using Multimodality Imaging. JACC Case Rep. 2021 Jan 20;3(1):31-33. doi: 10.1016/j.jaccas.2020.12.006
4. Bansal K, Gore M, Afzal M, Shams P, Nalabothu P. Anterior Myocardial Infarction. In: StatPearls. StatPearls Publishing; 2025. Accessed December 15, 2025. http://www.ncbi.nlm.nih.gov/books/NBK562234/
5. Kang N, Hsee L, Rizoli S, Alison P. Penetrating cardiac injury: overcoming the limits set by Nature. Injury. 2009 Sep;40(9):919-27. doi: 10.1016/j.injury.2008.12.008
6. Lee A, Hameed SM, Kaminsky M, Ball CG. Penetrating cardiac trauma. Surg Open Sci. 2022 Nov 17;11:45-55. doi: 10.1016/j.sopen.2022.11.001
7. Ziroldo AR, Pardi E, Beckett A, Ali J. Hemorrhage Control in Penetrating Cardiac Injury: A New Device Put to the Test in the

Advanced Trauma Operative Management (ATOM) Course. Panam J Trauma Crit Care Emerg Surg 2019; 8 (1):24-28

8. Ball CG, Lee A, Kaminsky M, Hameed SM. Technical considerations in the management of penetrating cardiac injury. Can J Surg. 2022;65(5):E580-E592. doi:10.1503/cjs.008521
9. Sun G, Huang S, Kang H, Wang B. Rescue of acute ST-elevation myocardial infarction secondary to traumatic coronary artery rupture: a case report. Eur Heart J Case Rep. 2025 Aug 16;9(9):ytaf402. doi: 10.1093/ehjcr/ytaf402
10. Lateef Wani M, Ahangar AG, Wani SN, Irshad I, Ul-Hassan N. Penetrating Cardiac Injury: A Review. Trauma Mon. 2012;17(1):230-232. doi:10.5812/traumamon.3461
11. Abu-Hmeidan JH, Arrowaili AI, Yousef RS, Alasmari S, Kassim YM, Aldakhil Allah HH, Aljenaidel AM, Alabdulqader AA, Alrashed MH, Alkhinjar MI, Al-Shammari NR. Coronary artery rupture in blunt thoracic trauma: a case report and review of literature. J Cardiothorac Surg. 2016 Aug 2;11(1):119. doi: 10.1186/s13019-016-0528-6
12. Brozzi NA, Cifuentes RO, Saba IC, Lineen EB, Loebe M, Ghodsizad A, Salerno TA. Heparineless off-pump coronary artery bypass in a patient with gunshot wound to chest and heart. J Card Surg. 2019 Jul;34(7):632-634. doi: 10.1111/jocs.14090
13. Zhang Z, Wang C, Tu T, Lin Q, Zhou J, Huang Y, Wu K, Zhang Z, Zuo W, Liu N, Xiao Y, Liu Q. Advancing Guideline-Directed Medical Therapy in Heart Failure: Overcoming Challenges and Maximizing Benefits. Am J Cardiovasc Drugs. 2024 May;24(3):329-342. doi: 10.1007/s40256-024-00646-4