Successful Conservative Management of Right Ventricular Perforation Caused by Temporary Pacemaker Placement during Complex Percutaneous Coronary Intervention: A Case Report

Fadhil P. Apriansyah[1,2], Muhammad Munawar[1], Dian L. Munawar[1], Beny Hartono[1], Muhammad Fadil[1], Darwin Indra[1]*

[1]Binawaluya Cardiac Center, Jakarta, Indonesia
[2]Fatmawati Hospital, Jakarta, Indonesia

Corresponding author:
Muhammad Munawar, MD, PhD. Binawaluya Cardiac Center. Jalan TB Simatupang 71, Jakarta 13750, Indonesia. Email: muna286@gmail.com

ABSTRACT

Cardiac tamponade is a critical condition that can result from complications during invasive cardiac procedures. This case report describes a 67-year-old male who developed right ventricular perforation leading to cardiac tamponade following elective complex percutaneous coronary intervention with rotational atherectomy and temporary pacemaker placement. By performing emergent pericardiocentesis and using a pigtail catheter with sustained negative pressure, we successfully managed a massive pericardial effusion of 2,600 cc. The patient stabilized without requiring surgical intervention, demonstrating favorable outcomes. This case underscores the importance of timely recognition and personalized management strategies in the conservative treatment of cardiac tamponade secondary to right ventricular perforation.

Keywords: *Cardiac Tamponade, Right Ventricular Perforation, Temporary Pacemaker, Percutaneous Coronary Intervention, Rotational Atherectomy.*

INTRODUCTION

Cardiac tamponade is a rare but life-threatening condition characterized by the accumulation of fluid in the pericardial space, leading to impaired cardiac function. The incidence of cardiac tamponade following invasive cardiac procedures ranges from 0.1% to 4.8%, depending on the complexity of the procedure.[1-3] If cardiac tamponade is not promptly recognized and treated, the morbidity and mortality associated with this condition can be significant.[3-5] One potential cause is right ventricular (RV) wall perforation, particularly in association with the placement of temporary pacemaker (TPM) leads.[2,6] Currently, there is no standardized management protocol for managing cardiac tamponade resulting from RV perforation; treatment approaches must be individualized, and surgical intervention is often preferred.[7-9] This case report highlights the successful conservative management of a patient who developed RV perforation due to TPM placement, illustrating an alternative approach to the management of this complication.

CASE ILLUSTRATION

A 67-year-old male with a history of percutaneous coronary intervention (PCI) in the left main bifurcation four years prior presented

with significant diffuse calcified stenosis in the right coronary artery (RCA). The pre-procedural electrocardiogram demonstrated a normal sinus rhythm, without evidence of previous inferior myocardial infarction (**Figure 1**). A complex PCI was performed on the RCA using rotational atherectomy followed by a cutting balloon. During the rotablation, the patient experienced recurrent unstable bradycardia, necessitating the placement of a transvenous temporary pacemaker (TPM) (**Figure 2**). The lead was placed at the right ventricular (RV) apex, and its position was confirmed under fluoroscopy in multiple projections (AP, LAO, and RAO views). The TPM was set at a pacing rate of 60 bpm, with an output of 3 mA and sensitivity of 3 mV.

The PCI was successful, and the TPM was removed at the end of the procedure. The total duration of TPM support was 77 minutes. The patient was transferred to an intensive cardiac care unit (ICCU). Within 15 minutes of being admitted, he developed vomiting, profuse sweating, severe chest pain, and signs of shock. His blood pressure was recorded as 60/40 mmHg. Electrocardiography indicated ST elevation in the inferior leads (II, III, and aVF), indicating an inferior wall infarct (**Figure 3**). An echocardiogram revealed a 1.55 cm pericardial effusion surrounding the heart (**Figure 4**). The patient was immediately sent back to the catheterization lab and underwent emergent pericardiocentesis with a subxiphoid approach, which produced a hemorrhagic effusion. A pigtail catheter was then inserted into the pericardial space to facilitate continuous pericardial tapping, successfully relieving the pressure and stabilizing the patient.

A repeat coronary angiography was conducted, revealing no occlusion or perforation in the RCA (**Figure 5**). To exclude the possibility of distal coronary perforation, a microcatheter was used for tip injections into all branches of the RCA, confirming the absence of perforation. Thus, perforation of the RV wall due to the TPM lead was determined to be the most probable diagnosis. Although right ventriculography or computed tomography could have confirmed this diagnosis, these procedures were not performed due to ongoing hemopericardium production and concerns about potential risks to the patient.

The last activated clotting time (ACT) measured during PCI was 324 seconds, reflecting a markedly anticoagulated state. Protamine was administered within 15 minutes of cardiac tamponade diagnosis, reducing the ACT to 156 seconds. Continuous pericardial tapping was performed for over six hours. During this process, 2,600 mL of hemorrhagic pericardial effusion was drained, 500 mL of which was auto-transfused back into the patient. Sustained negative pressure was applied via the pigtail catheter during this period to ensure that the pericardium adhered to the epicardium (**Figure 6**), which helped seal the RV perforation. The patient was also stabilized with vasopressors, isotonic solutions, and packed red blood cells.

A cardiac surgeon was consulted early in the process, and repair surgery was considered, given the severity of the situation. However, the interventional cardiologist suggested a more conservative approach, advising that we wait to see whether the bleeding would subside. By the sixth hour, the effusion had significantly decreased and eventually stopped. Since the patient was stable and showed no further signs of bleeding, the need for surgical intervention was ruled out.

The patient was then transferred back to the ICCU with the pigtail catheter in situ, which was still connected to a negative-pressure syringe. The cardiac surgeon remained on standby, ready to escalate to surgery if any deterioration occurred. Over the next 24 hours, pericardial production was minimal, and echocardiography confirmed no additional effusion. The pigtail catheter was then removed, and the patient was transferred to the regular ward. He was discharged two days after the operation. At a follow-up visit two weeks later, he was well and exhibited no symptoms.

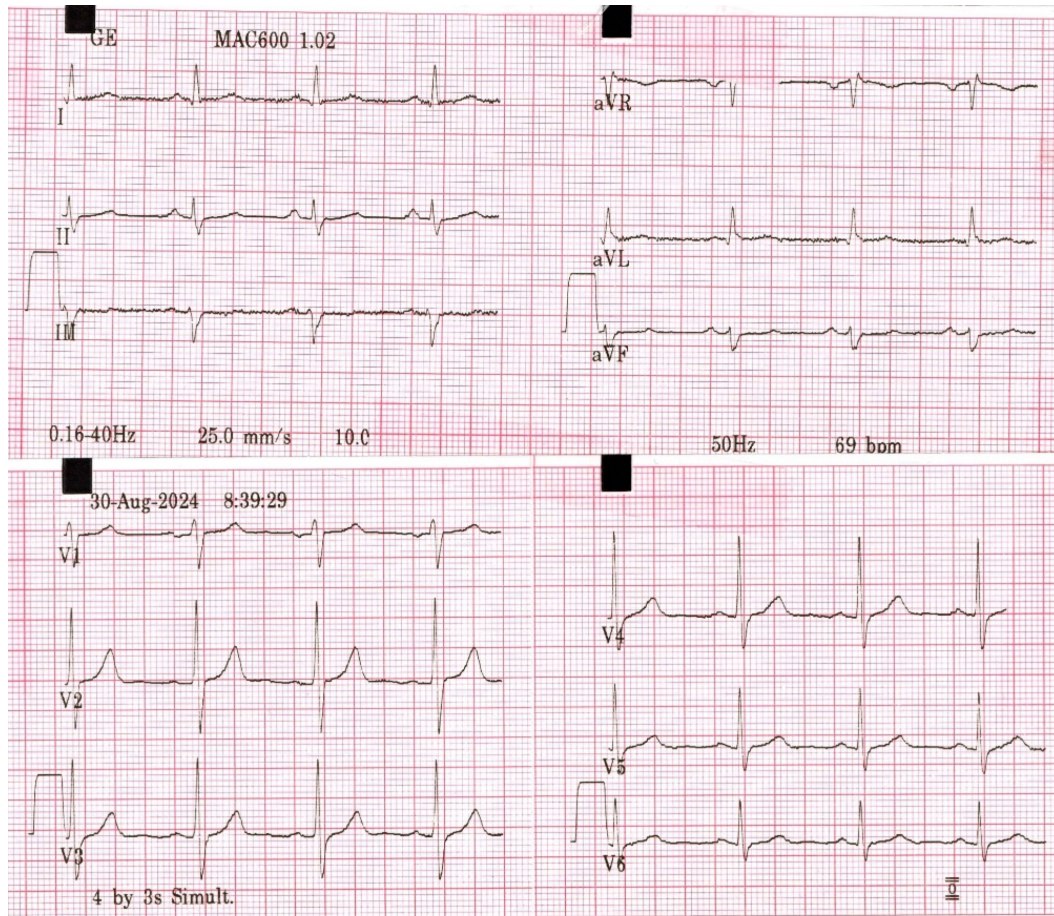

Figure 1. Pre-procedural twelve-lead electrocardiogram demonstrating normal sinus rhythm without pathological Q waves or ST-T segment changes, consistent with the absence of prior myocardial infarction.

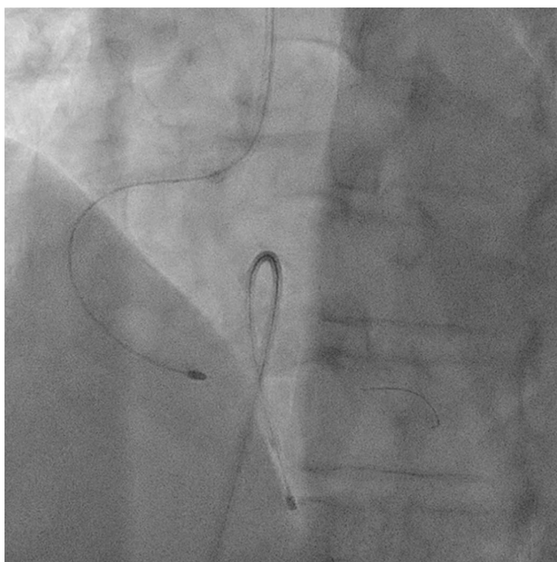

Figure 2. A transvenous temporary pacemaker lead positioned in the right ventricular apex during rotational atherectomy of the right coronary artery.

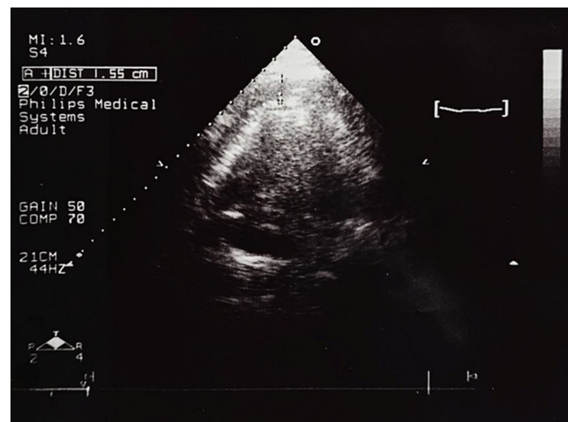

Figure 3. A twelve-lead electrocardiogram recording obtained in the Intensive Cardiac Care Unit demonstrates ST-segment elevation in the inferior leads and reciprocal ST-segment depression in the anterior leads.

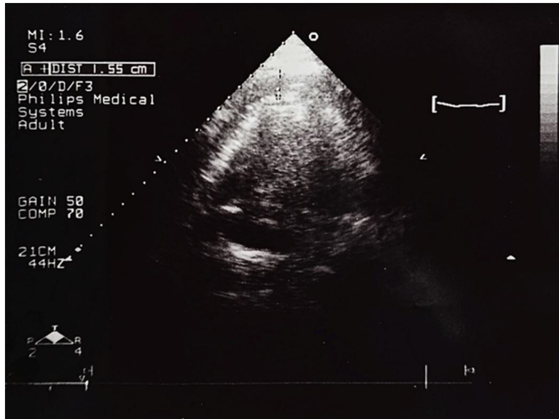

Figure 4. Echocardiographic image demonstrating pericardial effusion surrounding the heart, measuring 1.55 cm.

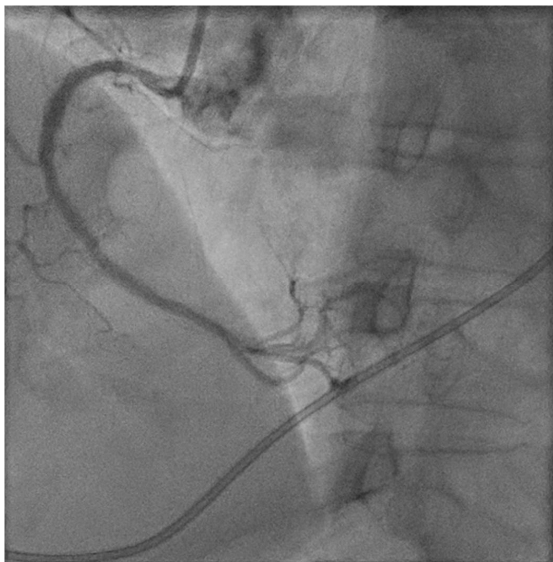

Figure 5. Repeat coronary angiography revealed no evidence of occlusion or perforation. A pigtail catheter was inserted into the pericardium via subxiphoid access.

Figure 6. A pigtail catheter connected to a 20cc syringe, which was placed in a negative pressure state using a smaller syringe to create suction. This setup facilitates the continuous drainage of pericardial fluid and promotes the adhesion of the pericardium to the epicardium.

DISCUSSION

Cardiac tamponade is a rare but serious complication that emerges after invasive cardiac procedures such as PCI and TPM placements. Its reported incidences range from 0.1% to 4.8%.[3] This variability depends on the patient's characteristics, the complexity of the procedures, and any underlying cardiovascular conditions.[1] If not promptly addressed, cardiac tamponade can lead to mortality rates as high as 42% to 59%.[3-5] However, timely recognition and intervention significantly reduce this risk and can prevent severe outcomes.[4]

In this case, immediate pericardiocentesis and continuous monitoring were crucial to stabilizing the patient and halting the progression of the complication. The potential for high mortality underscores the importance of healthcare providers' awareness of the signs and symptoms of cardiac tamponade, particularly in patients presenting with chest pain and hypotension following cardiac procedures. The clinical team's rapid assessment and initiation of treatment were vital in achieving a favourable outcome.

Identifying the aetiology of cardiac tamponade in this scenario presented diagnostic challenges. Initially, coronary perforation was a primary concern due to the recent complex PCI involving rotational atherectomy. However, subsequent coronary angiography and microcatheter injections revealed no evidence of coronary artery perforation, making perforation of the RV wall by the TPM lead the most probable diagnosis. In some cases, spontaneous closure of the defect or perforation may occur immediately after the TPM lead is withdrawn due to myocardial contraction. However, several factors can prevent spontaneous closure, including the use of antiplatelet and anticoagulant agents, as observed in our case. Although advanced imaging modalities such as computed tomography (CT) or right ventriculography could

have provided confirmation, they were deemed inappropriate due to ongoing bleeding and the potential risk to the patient.[6-10]

This scenario also underscores the relevance of TPM settings and anatomical susceptibility. Although the pacing output (3 mA) and rate (60 bpm) were within conventional safety ranges, even a relatively short dwell time of 77 minutes may increase the risk of perforation if the lead tip exerts persistent mechanical pressure. The RV apex, while commonly chosen for lead placement, represents an area of thinner myocardial wall compared to the interventricular septum, and thus constitutes a 'locus minoris resistentiae' (point of lesser resistance). This structural predisposition, in combination with anticoagulation during complex PCI, likely facilitated perforation in our patient despite seemingly standard pacing parameters. These considerations underscore the importance of balancing TPM settings, lead positioning, and procedural anticoagulation in patients undergoing complex interventions.

Coronary occlusion was initially considered as a differential diagnosis due to the patient's inferior ST-segment elevation. However, repeat coronary angiography ruled out any coronary issues. Consequently, the observed ST-segment elevation in the inferior leads could be primarily attributed to myocardial injury caused by the TPM lead perforating the RV wall. This direct mechanical injury can lead to localized myocardial damage, triggering an inflammatory response and potentially resulting in myocardial cell necrosis. While this phenomenon has not been thoroughly described in the literature, a similar occurrence was documented in a case report by Tien-Lung Po et al., who noted ST elevation in the anterior wall due to left ventricular perforation following the placement of a transcutaneous pigtail catheter placement.[11]

Several key interventions are involved in effectively managing cardiac tamponade resulting from RV perforation, although no standard management protocol currently exists.[9] While surgery is generally recommended for patients presenting with cardiac tamponade, management strategies should be individualized based on the patient's conditions. In this case, emergent pericardiocentesis provided immediate relief from the pressure of the accumulated fluid. Over six hours, a total of 2,600 cc of hemorrhagic fluid was drained an exceptionally large volume for pericardial effusion. The administration of protamine to reverse heparinization was crucial in mitigating the effects of anticoagulation, which is particularly important in the context of ongoing bleeding. Protamine is safe for use after PCI when deemed necessary.[12]

Continuous pericardial tapping through a pigtail catheter enabled sustained drainage of pericardial fluid. The application of sustained negative pressure facilitated the adherence of the pericardium to the epicardium, promoting the sealing of the RV wall perforation and preventing fluid reaccumulation. Maintaining the negative pressure system stopped the bleeding without the need for open-heart surgical intervention. This case exemplifies how non-invasive techniques can yield favorable outcomes when appropriately executed promptly, highlighting the importance of individualized patient management in the treatment of cardiac complications.

CONCLUSION

This case highlights the successful conservative management of right ventricular perforation due to temporary pacemaker placement. A combination of rapid intervention and appropriate management, such as sustained negative pressure drainage, proved effective in making surgical intervention unnecessary and ensuring a favorable patient outcome. Further studies are warranted to explore the efficacy of similar management strategies in larger cohorts.

ETHICS APPROVAL

Informed consent for this case report to be published was obtained from the patient.

ACKNOWLEDGMENTS

We would like to thank all the staff at Binawaluya Cardiac Center for their support during the patient's care, as well as our colleagues who provided feedback on this manuscript.

The authors acknowledge the use of generative AI solely for language assistance in drafting this manuscript. The thoughts, ideas, and

arguments presented in this paper are entirely our own.

CONFLICT OF INTERESTS

The authors declare that there is no conflict of interest.

FUNDING

This study received no external funding.

UNDERLYING DATA

All data underlying the results are available as part of the article, and no additional source data are required.

REFERENCES

1. Harnek J, James S, Lagerqvist B. Coronary artery perforation and tamponade - incidence, risk factors, predictors and outcomes from 12 years' data of the SCAAR registry. Circ J. 2020;84:43-53.
2. Ayerbe JL, Sabaté RV, García CG, et al. Temporary pacemakers: current use and complications. Rev Esp Cardiol. 2004;57(11):1045-52.
3. Adamczyk M, Wasilewski J, Niedziela J, et al. Pericardial tamponade as a complication of invasive cardiac procedures: a review of the literature. Adv Interv Cardiol. 2019;15(4):394-403.
4. Lee MS, Shamouelian A, Dahodwala MQ. Coronary artery perforation following percutaneous coronary intervention. J Invasive Cardiol. 2016;28(3):122-31.
5. Fejka M, Dixon SR, Safian RD, et al. Diagnosis, management, and clinical outcome of cardiac tamponade complicating percutaneous coronary intervention. Am J Cardiol. 2002;90:1183–6.
6. Kossaify A. Temporary endocavitary pacemakers and their use and misuse: the least is better. Clin Med Insights Cardiol. 2014;8:9–11.
7. Oh, S. Cardiac perforation associated with a pacemaker or ICD lead. In: Modern Pacemakers - Present and Future. London: IntechOpen; 2011. Available from: https://doi.org/10.5772/13424.
8. Lua PS, Lee KT, Wu PW, et al. A rare complication: right ventricular perforation by temporary pacemaker lead. J Med Radiat Sci. 2017;42:009.
9. Aliyev F, Çeliker C, Türkoğlu C, et al. Perforations of right heart chambers associated with diagnostic electrophysiology catheters and temporary transvenous pacing leads. Türk Kardiyol Dern Ars. 2011;39(1):16-22.
10. Kumar S, Yassin H, Esan O, Budzikowski AS, Kassotis JT. Mechanism and management of pacing lead-related cardiac perforation. In: Roka A, editor. Current Issues and Recent Advances in Pacemaker Therapy. London: IntechOpen; 2012. Chapter 6. Available from: https://doi.org/10.5772/48630.
11. Po TL, Hung HF, Yen YT, et al. Left ventricular perforation following transcutaneous pigtail catheter placement mimicking anterior wall myocardial infarction: an unusual complication. J Acute Med. 2024;14(3):125.
12. Briguori C, Di Mario C, De Gregorio J, et al. Administration of protamine after coronary stent deployment. Am Heart J. 1999;138(1):64-8.