Unusual presentation of right ventricular branch occlusion during percutaneous coronary intervention

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Abstract

Right ventricular (RV) infarction usually occurs in the setting of inferior wall myocardial infarction due to proximal right coronary artery (RCA) occlusion. A rarer cause of RV infarction involves an isolated RV branch occlusion during a percutaneous coronary intervention (PCI) to revascularize the RCA. In this case, the isolated RV branch occlusion resulted in transient unexpected ST-segment elevations in the anterior precordial leads. The patient developed transient chest pain peri-procedurally and repeat angiography showed widely patent stents but complete occlusion of the isolated RV branch. This case highlights a rare and unusual presentation of RV branch occlusion with anterior ST-segment elevations.

Keywords: coronary artery disease, percutaneous coronary intervention, right ventricular infarction

Introduction

Isolated occlusion of the right ventricular (RV) branch of the right coronary artery (RCA) is extremely rare and sometimes presents with unusual ST-segment elevation (STE) in the anterior precordial leads. Thus, the electrocardiographic pattern of infarction from this branch is not well established in relation to the coronary anatomy. Here we present a case of percutaneous coronary intervention (PCI) to the RCA in which a jailed right ventricular branch caused notable chest pain and unusual STE in the anterior and inferior leads. The STE was unique as they waxed and waned with repeat opening and re-occlusion of the artery. These profound ECG changes illustrate a rare presentation of RV branch occlusion.

Case

A 66-year-old man with previously non-obstructive coronary artery disease underwent elective coronary angiography for chest pain after a nuclear myocardial perfusion study revealed a medium-sized, moderate intensity, reversible inferior wall perfusion defect. His baseline ECG was unremarkable (Figure 1A). Left coronary angiography showed mild to moderate disease unchanged from prior coronary angiography. Right coronary angiography and intravascular ultrasound (IVUS) revealed severe proximal and mid-RCA stenosis at the RV branch bifurcation (Video 1).

Elective PCI was performed and two Xience Skypoint 4.0 × 18 mm drug-eluting stents (Abbott) were deployed to the mid and proximal RCA. After post-dilating the mid-RCA stent, the jailed RV branch had TIMI II flow (Video 2), and the patient developed chest pain. Angiography and IVUS of the RCA showed patent, well-opposed stents with TIMI 3 flow and no evidence of dissection, spasm, or thrombus. Balloon angioplasty to the proximal RV branch with a Trek 1.5 × 12 mm compliant balloon (Abbott), restored TIMI 3 flow, and relieved chest pain (Video 3).

In the recovery area, severe chest pain recurred with ECG showing new STE in anterior and inferior leads (Figure 1B). Repeat RCA angiography showed widely patent stents and TIMI 3 flow (Video 4), but complete occlusion of the RV branch, which could not

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DOI: 10.12746/swrccc.v12i53.1387

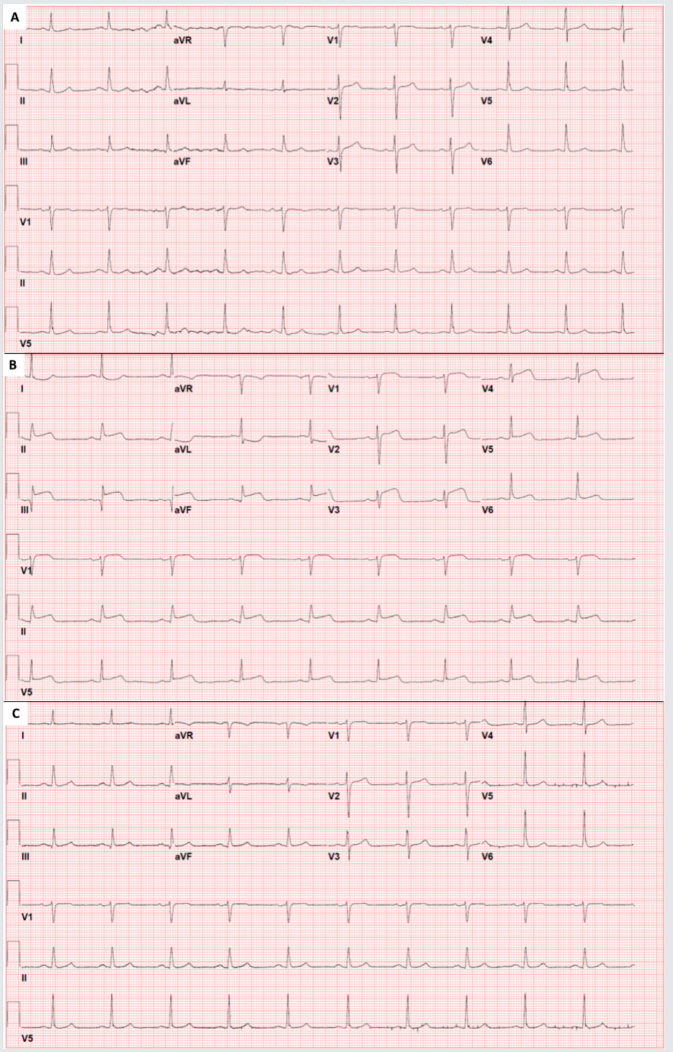

Figure 1. Electrocardiograms: Pre-procedure with normal sinus rhythm and absence of ST elevations (**A**), periprocedural with ST elevations in anterior and inferior leads (**B**), and post-procedure with resolution of ST elevations (**C**).

be wired despite multiple attempts (Video 5). The procedure ended but the patient's chest pain and STE persisted. An emergent transthoracic echocardiogram showed normal biventricular function, no wall motion abnormalities, and a mildly dilated right ventricle. He was given additional analgesic medications, and his chest pain and STE completely resolved within an hour (Figure 1C). He was monitored overnight without recurrence of chest pain or STE.

Discussion

Right ventricular infarction most commonly occurs in conjunction with an inferior wall myocardial infarction from occlusion of the proximal RCA which is demonstrated with inferior STE. Isolated right ventricular infarction is rare and may occur during PCI due to side branch occlusion.[1] Side branch occlusion during PCI is an infrequent, though potentially disconcerting, complication with rates of peri-procedural occlusion up to 12.5%.[2] Peri-procedural occlusion provides insight into RV branch occlusion pathology and ECG changes, including unusual ST-elevation in leads V1–V4. Patients may experience chest pain.[3–6] Often times these side branch occlusions are uncomplicated, and ECG findings recover within a few hours.[3,4] Post-procedural troponin elevations have also been noted.[6] Flow may resolve spontaneously during or shortly after the procedure.[3] Periprocedural interventions are not typically performed, although cases of peri-procedural balloon angioplasty have been reported, like in this case.[7,8]

Patients with underlying chronic kidney disease (CKD) who undergo a PCI and suffer an RV branch occlusion may be more susceptible to significant adverse sequelae, including worsening RV function and major adverse cardiac events (MACE).[9] One non-randomized retrospective study analyzed the long-term prognosis of right ventricular branch compromise (RVBC) and CKD in 90 patients who underwent PCI for STEMI from a culprit lesion in the proximal to mid-RCA. The patients were divided into two groups of RVBC and non-RVBC using post-PCI angiography. Their long-term prognosis was measured over 12 to 74 months. Results showed that RV function was significantly worse in RVBC, and MACE was also significantly higher. The study concluded that RVBC after PCI was associated with poor long-term outcomes, both baseline CKD and RVBC following PCI can portend a poor prognosis, and the status of RV branch flow is critical in patients with CKD at baseline.[9] However, another study of 54 PCI patients (12 with periprocedural RVBC) evaluated with cardiac MRI noted no changes in RVEF in patients who had an RV occlusion during PCI, although a slight increase in right ventricular end-systolic volume from baseline to follow-up (72.5 ± 20.0 vs. 77.4 ± 20.7 mL, $p = 0.05$) was noted.[10]

Since RV branch occlusion is an unintended consequence of PCI, there is concern that certain periprocedural techniques and stent materials may increase the risk of this complication. For example, a study of 54 patients, who underwent PCI for chronic total occlusion of the RCA, suggested that the risk of RV branch occlusion may be increased from dissection and reentry techniques in addition to extensive stent implantation techniques. The authors concluded that RV branch occlusion did not significantly decrease RV ejection fraction at follow-up.[10]

Since RV branch occlusions sometimes present with STE in precordial leads V1–V6, one study discussed using vector analysis to correlate coronary territory involvement when STE pattern recognition can sometimes be misleading.[4] The authors used vector analysis to suggest that the RCA was the culprit artery by describing a greater magnitude of STE in lead III than II, and ST-depression in lead I, with a resultant ST-segment vector directed inferiorly and about 110° to the right in the frontal plane.[4] Application of the vector concept can help avoid misinterpretation of anterior STE as anterior or anteroseptal MI and help recognize patients with RV compromise, who may be susceptible to hemodynamic collapse.

Conclusion

Anterior and inferior STE is a rare presentation of isolated RV infarction as reported in several case studies. Isolated RV infarction can result in precordial STE changes on ECG without LV injury. In our case, the unique aspect of anterior STE was the waxing and waning nature as the artery re-occluded and then opened repeatedly. An interventional cardiologist performing PCI to the RCA should consider RV branch occlusion to explain certain periprocedural ECG changes and associated symptoms.

Acknowledgments

We would like to thank Charles Q Cui, MD for assisting with the percutaneous coronary intervention presented in this case and bringing this unique clinical case to our attention.

Videos

See video files 1–5 for angiography studies.

Article citation: Vattikonda KS, Peterson CJ, Sternberg M, Berzingi CO. Unusual presentation of right ventricular branch occlusion during percutaneous coronary intervention. The Southwest Respiratory and Critical Care Chronicles 2024;12(53):71–74
From: Department of Medicine, Virginia Tech Carilion School of Medicine, Roanoke, VA
Submitted: 6/27/2024
Accepted: 9/17/2024
Conflicts of interest: none

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