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Case Report

A case of percutaneous coronary intervention of the right coronary artery in a situs inversus patient with foreshortening of lesion revealed by intravenous ultrasound imaging technology

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Abstract

Situs inversus totalis is a rare anomaly in which the internal organs are transposed oppositely as mirror images. Due to its rarity, interventionalists are less likely to be acquainted with angiography in this unique population. In the case of lesion ambiguity, different invasive diagnostic tools can be used to further evaluate lesion severity, including fractional flow reserve, instantaneous wave-free ratio and intravenous ultrasound (IVUS). In this case, we discuss the usefulness of IVUS as a beneficial tool in evaluation of angiographically ambiguous lesions due to foreshortening. Dextrocardia presents unique challenges to the interventional cardiologist secondary to difficulty in acquiring adequate views and unfamiliarity with mirroring of anatomy, and thus angiography can result in inaccurately assessed lesions. We demonstrate how IVUS can be used in evaluation of such lesions for more accurate evaluation, precision in stent placement and in turn better patient outcomes.

CASE DESCRIPTION

A 71-year-old male with past medical history of complete situs inversus, hypertension, atrial fibrillation, atrial septal defect, bilateral pulmonary embolism, chronic obstructive pulmonary disease and self-reported 'heart aneurysm' was admitted to the hospital with crushing right-sided chest pain radiating into the neck beginning that morning, with accompanying palpitations, shortness of breath, weakness and hand numbness. He denied

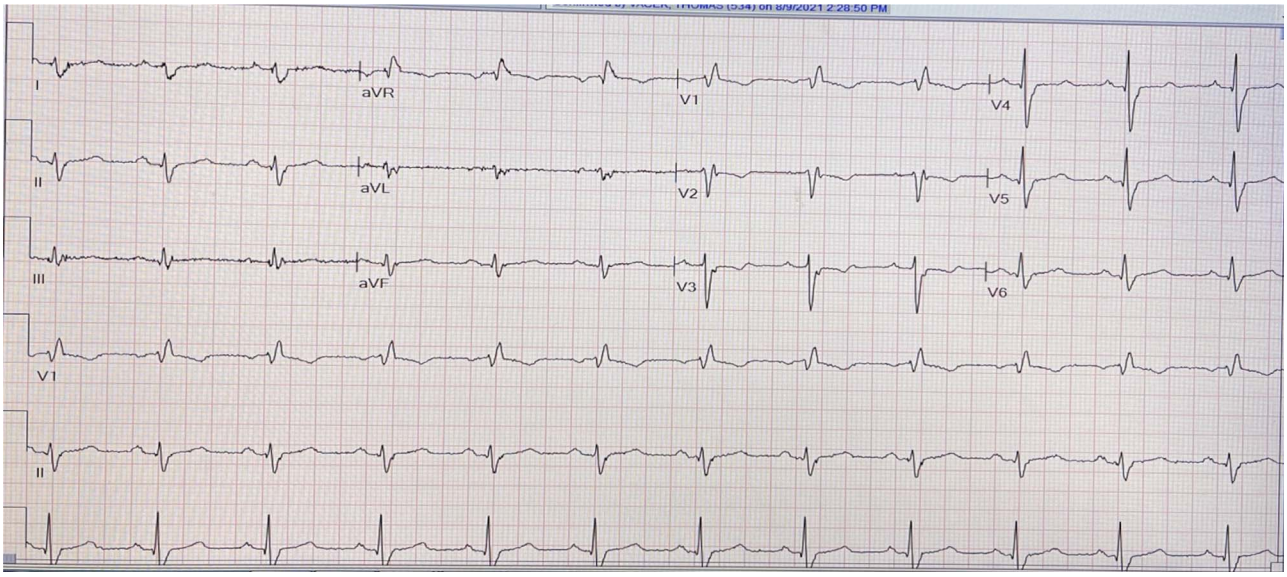

Figure 1. Initial EKG 08.08.2021; initial EKG demonstrating sinus rhythm, QRS 136 ms, rate 71 bpm, QTC 491 ms, normal axis and no ischemia.

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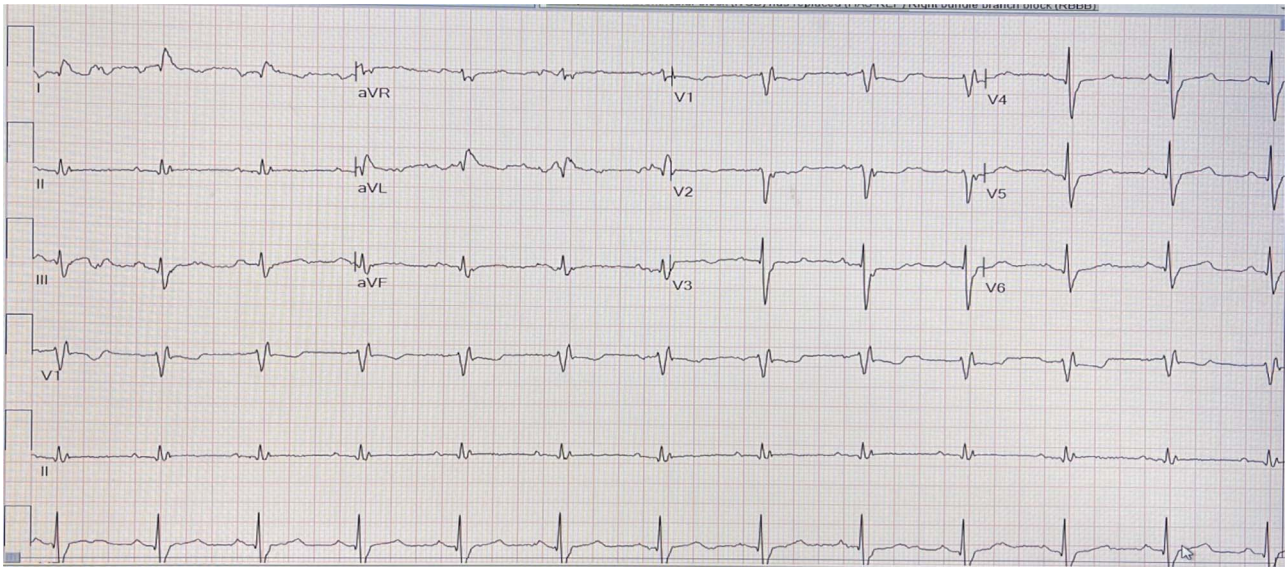

Figure 2. Follow-up EKG 08.10.2021; repeat EKG demonstrating right bundle branch block, QRS 134 ms, T wave abnormalities, rate 75 bpm and QTc 482 ms.

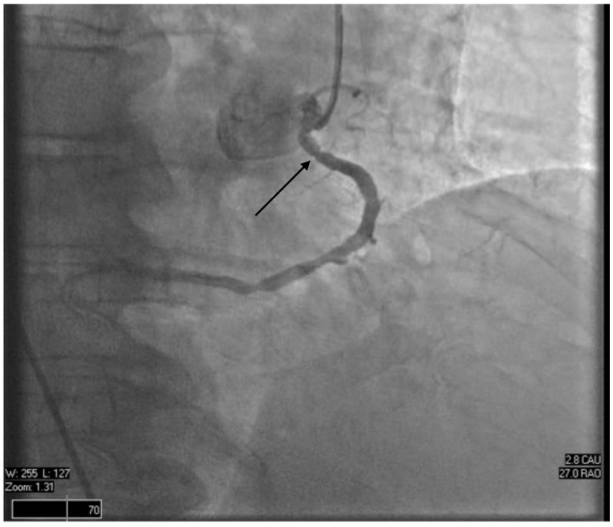

Figure 3. RAO view of RCA showing ambiguity; RAO view of the right coronary artery showing intermediate lesion (black arrow).

any prior history of coronary artery disease. Family history is significant for aortic aneurysm in his mother, who died of aneurysm-related complications at age 57. The patient had a 65-pack year smoking history. He was not taking anticoagulants at the time of admission. Electrocardiogram (EKG) on admission showed sinus rhythm with right bundle branch block (RBBB), rate 71 beats per minute (bpm), QRS 136 milliseconds (ms), corrected QT (QTc) 491 ms, normal axis and no ischemia (Fig. 1). Repeat EKG also exhibited RBBB, QRS 134 ms with T wave abnormalities, rate 75 bpm and QTc 482 ms (Fig. 2). Computed tomography angiography chest with and without contrast showed no evidence of pulmonary embolism or active disease. Troponins were positive, and rose from initial 0.06 to 2.766 maximum, then decreased to 2.167 over admission. Echocardiogram showed normal left ventricle cavity size with ejection fraction 50–55%, no wall motion abnormalities, and mild–moderate aortic valve regurgitation and mild mitral valve regurgitation. Cardiac catheterization with percutaneous coronary intervention (PCI) was performed the day following admission. Approach involved a modified Seldinger technique and right femoral access as the brachial artery was too narrow. An ambiguous lesion of the right coronary artery

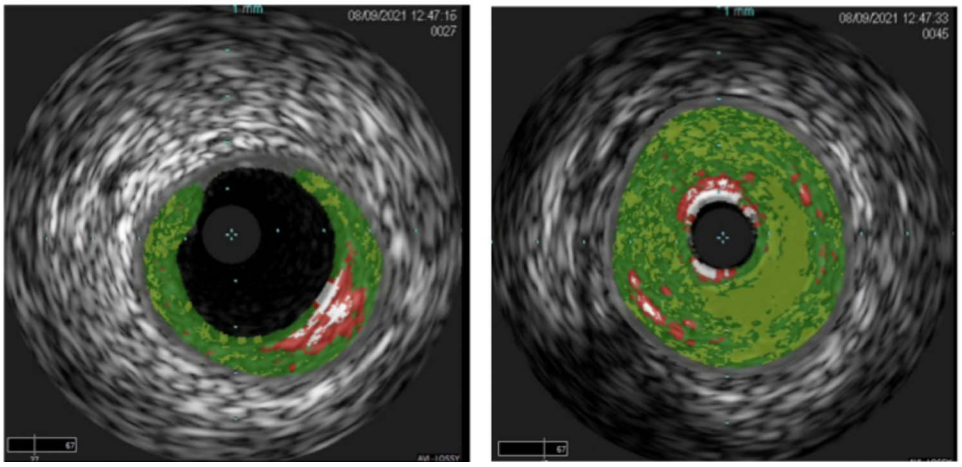

Figure 4. IVUS view of RCA lesion; IVUS imaging of the RCA lesion demonstrating plaque morphology and stenosis of 80–90%.

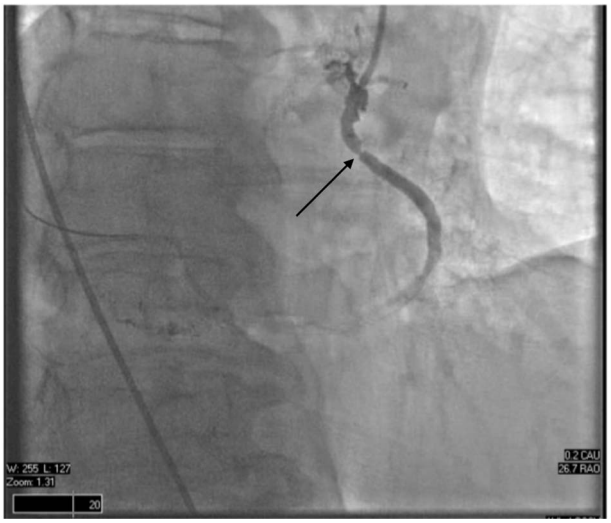

Figure 5. RAO view with caudal angulation showing napkin ring lesion; adjusted RAO view with caudal angulation demonstrating extent of napkin-ring lesion of the RCA (black arrow).

(RCA) was seen on right anterior oblique (RAO) view, as seen in video 1, and subsequently investigated using intravenous ultrasound technology (IVUS) (Figs 3 and 4). IVUS was chosen for its unique ability to provide real-time views of the intraluminal space allowing for better assessment of disease burden than angiography alone in intermediate and ambiguous lesions. The lesion was found to be an 80–90% occluded napkin-ring lesion of the proximal RCA. Video 2 demonstrates how the views were adjusted to account for mirroring, after which the lesion could be better appreciated (Fig. 5). Without the use of IVUS, the lesion could have otherwise been underappreciated due to foreshortening secondary to unique anatomy of dextrocardia. PCI was performed using a 4.5 × 15 mm drug-eluting stent, and the patient was subsequently started on triple therapy consisting of apixaban, aspirin and clopidogrel.

DISCUSSION

Situs inversus totalis, or situs inversus with dextrocardia, is a rare anomaly in which the internal organs are transposed oppositely as mirror images. It is believed these individuals have similar risk of coronary artery disease as the general population [1]. The first report of coronary angiography in dextrocardia was in 1974, and the first report of PCI dextrocardia was in 1987 [1]. Reports on PCI in this population have been limited, likely due to the low incidence of the disorder (1/10 000) [1]. It can be difficult to identify myocardial infarcts in these patients, especially if dextrocardia presence is unknown, as presenting complaint may be right-sided chest pain with possible radiation to the right shoulder and arm [2]. EKG interpretation can also be misleading if dextrocardia is unknown at time of test [3]. Guidelines for intervention are the same as in non-dextrocardia patients, but the operator must take into account the unique anatomical challenge that comes with transposition of the heart and coronaries to ensure optimal benefits [1].

Coronary angiography is the gold standard to assess coronary stenosis. A stenotic diameter of >70% in non-left main artery (LMA) disease and >50% for LMA disease has been the standard for intervention [4]. Intermediate stenosis, defined as visual angiographic diameter stenosis severity between 40 and 69% [4], creates a challenging question for the operator: is intervention warranted? The most recent guidelines of the American College of Cardiology support the use of fractional flow reserve (FFR) and instantaneous wave-free ratio (iFR) as invasive methods to assess the hemodynamic significance of intermediate lesions [4]. IVUS is an alternative intraprocedural diagnostic modality to evaluate such lesions. IVUS displays real-time views on plaque morphology providing valuable information on lesion severity as

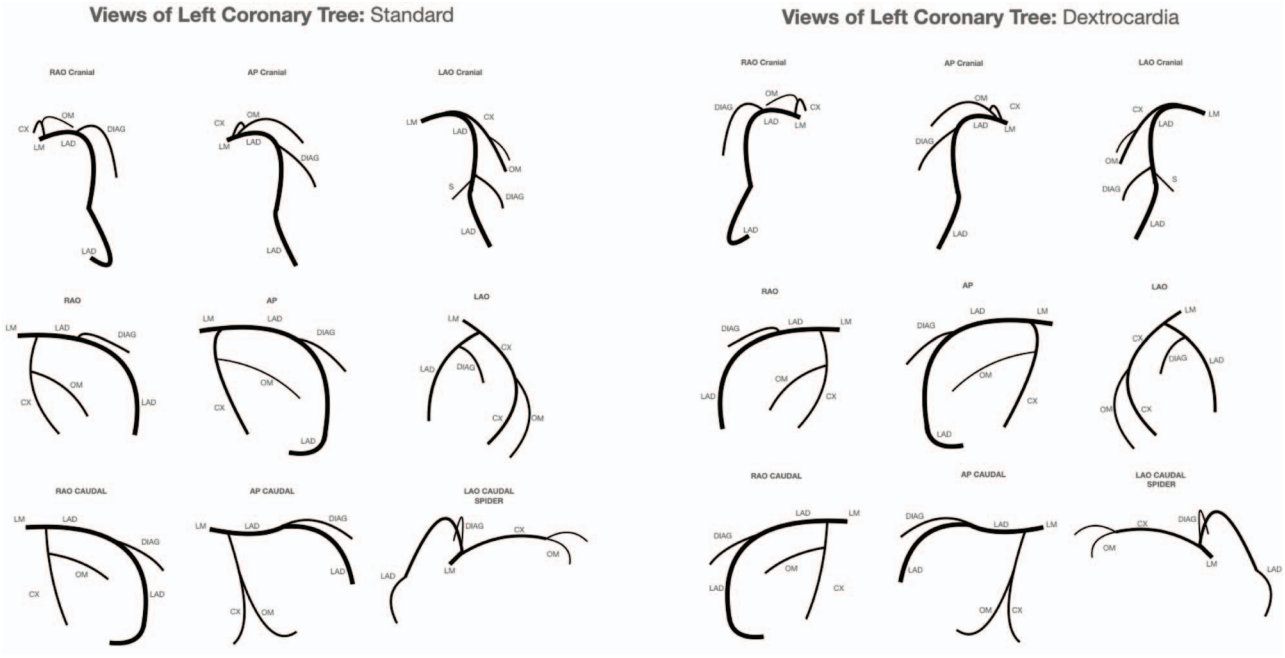

Figure 6. Left coronary system angiography views: angiography views of left coronary tree: standard views are the angiographic views that would be seen in a patient with an anatomically standard position of the heart, on the anatomical left side of the thoracic cavity; dextrocardia views are those seen on angiography in a patient with dextrocardia, where the heart is on the anatomical right side of the thoracic cavity.

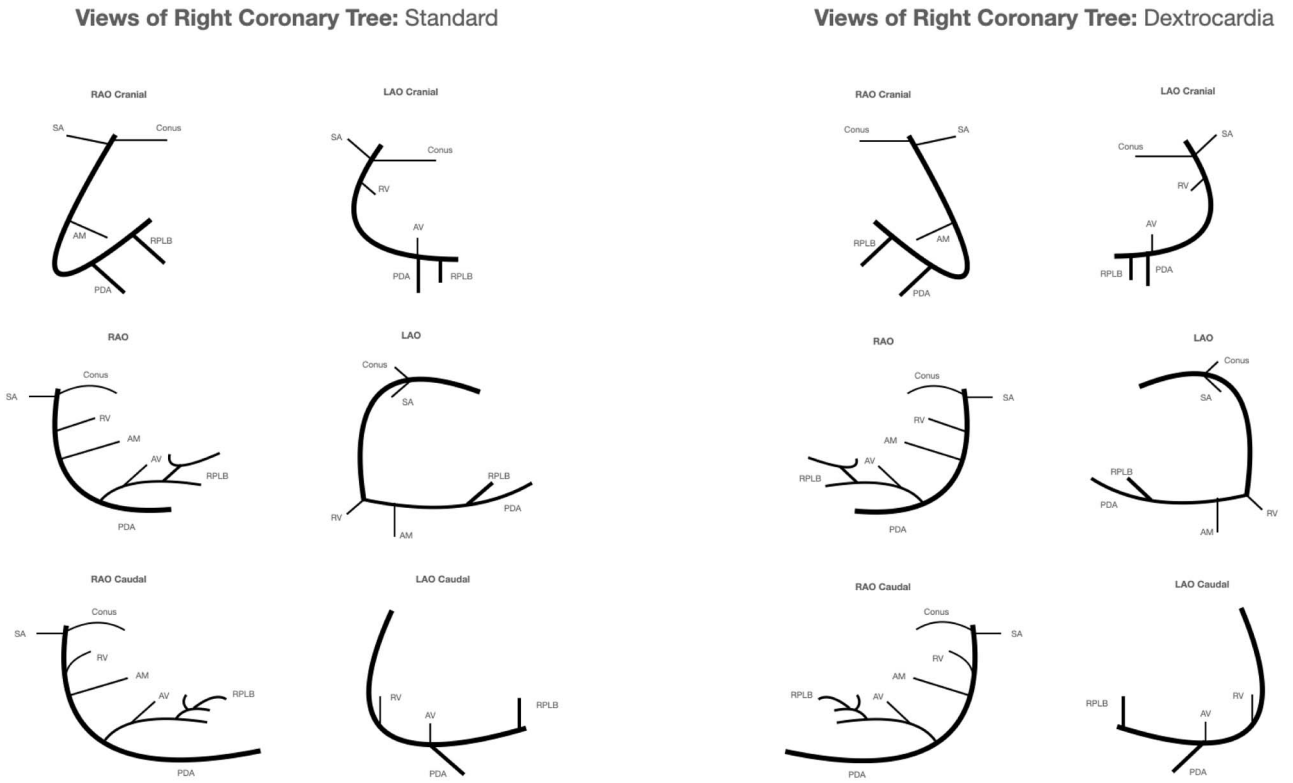

Figure 7. Right coronary system angiography views: angiography views of right coronary tree: standard views are the angiographic views that would be seen in a patient with an anatomically standard position of the heart, on the anatomical left side of the thoracic cavity; dextrocardia views are those seen on angiography in a patient with dextrocardia, with their heart on the anatomical right side of the thoracic cavity.

well as for stent placement and sizing [5]. IVUS's cross-sectional intraluminal view provides significant advantage in assessment of ambiguous lesions when compared to the 2D x-ray projection of angiograms alone, and has been shown to yield superior outcomes, i.e. a decrease in incidence of under-expansion and incomplete apposition to the vessel wall [6, 7]. In situs inversus, IVUS can be particularly useful, especially when the operator is unaccustomed to seeing reverse imaging of the heart and taking into consideration the anatomical issues that can present in ways such as lesion foreshortening.

Review of literature shows differing suggestions on angles for optimum viewing based on which vessel requires intervention [2, 8]. Although our focus emphasizes the helpful use of technology for intermediate lesions in populations with unique anatomy such as dextrocardia, it is important to point out the differences in angiographic views. We comprehensively illustrate the vessel views in standard and mirrored form in Figs 6 and 7. Note each angiographic camera angle is the same for discerning each respective portion of a coronary artery, the only difference being the views are mirror images of each other necessitating directionally opposite torquing for cannulation. For example, the catheter points toward the left side of the screen instead of the right when engaging the left coronary ostium in the left anterior oblique (LAO) view. The catheter points to the right side of screen instead of left side when engaging the RCA ostium in the LAO view. Standard catheters can be used, but manipulation must be in opposite direction for optimal management, i.e. counterclockwise rotation of catheter for RCA cannulation as compared to the standard clockwise rotation.

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Thomas Vacek provided contributions in concept and outline design, knowledge of angiographical views, expert guidance in figure editing for accuracy, and approved final draft of manuscript. Rebecca Kager drafted the article, designed and created the figures, compiled and created references, and finalized the final draft of the article including format. All authors agree to be accountable for all aspects of the work ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

CONFLICT OF INTEREST STATEMENT

No conflict of interest.

FINANCIAL DISCLOSURES

None reported.

ETHICAL APPROVAL

None reported.

INFORMED CONSENT

The patient in this case report provided verbal consent prior to transcription of manuscript.

GUARANTOR

Rebecca L. Kager.

REFERENCES

1. Long W, He Z, Wang X, Wu H, Chen Y, Yang Z. Successful drug-eluting stent implantation in a male patient with dextrocardia: a case report. *Open Med (Wars)* 2017;**12**:481–4.
2. Jain A, Jagadheesan K, Satheesh S, Anantharaj A. Primary PCI for acute myocardial infarction in a patient with situs inversus totalis and dextrocardia. *J Cardiol Cases* 2021;**23**:267–70.
3. Tat KK, Said A, Yee OY, Adinan SN, Kiam OT. ST-elevation myocardial infarction in situs inversus dextrocardia: a case report. *ASEAN Heart J* 2016;**24**:10.
4. Committee W. 2021 ACC/AHA/SCAI Guideline for Coronary Artery Revascularization: A Report of the ACC/AHA Joint Committee on Clinical Practice Guidelines. *Journal of the American Coll of Cardiology* 2022;**79**:e21–129.
5. Nogic J, Prosser H, O'Brien J *et al*. The assessment of intermediate coronary lesions using intracoronary imaging. *Cardiovasc Diagn Ther* 2020;**10**:1445–60.
6. Tabl MA, University, B., Arafa OS, Anin HAE, Khamis H, Hospital WEN. CRT-600.01 assessment of intermediate coronary artery lesion with fractional flow reserve (FFR) versus intravascular ultrasound (IVUS): *J Am Coll Cardiol Intv*. 2016;**9**:(4_Supplement) S57
7. Shammas NW, Radaideh Q, Shammas WJ, Daher GE, Rachwan RJ, Radaideh Y. The role of precise imaging with intravascular ultrasound in coronary and peripheral interventions. *Vasc Health Risk Manag* 2019;**15**:283–90.
8. Goel PK. Double-inversion technique for coronary angiography viewing in dextrocardia. *Catheter Cardiovasc Interv* 2005;**66**:281–5.