Case Report

Coronary artery bypass grafting in a patient with situs inversus totalis

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Abstract

Situs inversus totalis (SIT) describes a complete mirror image of the visceral organs in the thoracic and abdominal cavities. Dextrocardia, in combination with SIT, is a rare congenital anomaly with a frequency of 1:10 000, and coronary heart disease may occur with a similar frequency and manifestation as in the general population. Coronary computed tomography (CT) angiography is useful for accurately assessing the coronary artery origin and position for preprocedural planning of difficult coronary artery catheterisation in SIT. In this case, invasive coronary angiography (ICA) was performed from the same angle but on the opposite side compared to standard angiography. With the use of volume-rendered three-dimensional and curved reformatted images reconstructed from coronary CT angiography, the advancement of guidewires and catheters during ICA as well as the planning of surgical procedures can be performed more safely.

Keywords: situs inversus totalis, dextrocardia, coronary computed tomography angiography, invasive coronary angiography, coronary artery bypass graft, coronary artery disease

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Case report

A 73-year-old Caucasian male presented with chest pain. His family history was strongly positive for coronary heart disease.

The physical examination unveiled a chest wall deformity known as pectus excavatum. Electrocardiography results exhibited a gradual decline in R-wave amplitude from leads V1 to V6, which is indicative of dextrocardia. Transthoracic echocardiography confirmed the presence of dextrocardia.

A contrast-enhanced cardiac computerised tomography (CT) examination was performed on a 128-slice single-source scanner (Somatom Go Top; Siemens Healthcare, Forchheim, Germany). CT examination revealed a situs inversus totalis (SIT) anomaly (Figs 1, 2). Coronary CT angiography (CCTA) showed a mixed plaque in the distal left main coronary artery (LMCA), extending to the proximal left anterior descending artery (LAD). Significant high-grade (> 90%) stenosis due to a mixed plaque was detected in the proximal LAD.

Invasive coronary angiography (ICA) was performed from the same angle but the opposite side compared to standard angiography, with shots taken from the left instead of the classical right position, and vice versa. During the procedure, 90% stenosis was observed in the distal part of the LMCA, and 95% stenosis was identified in the proximal part of both the LAD and the left circumflex artery (LCx) (Fig. 3).

Coronary artery bypass graft (CABG) was recommended to the patient. The surgeon could not use the right and left internal mammarian arteries because of the pectus excavatum deformity, and performed CABG with full venous grafts. Saphenous grafts originated from the aorta at the midline and extended towards the right side due to the presence of coronary arteries located on the right side, which is opposite to their usual anatomical position (Fig. 4).

Discussion

Situs refers to the position of the visceral organs in the thoracic and abdominal cavities. Situs solitus describes the normal anatomical positions of cardiac structures and thoracoabdominal organs. In SIT, there is a complete mirror-image arrangement with normal atrioventricular and ventriculoarterial connections that result in normal circulation. The morphological left atrium is on the right and the morphological right atrium is on the left. The left-sided lung is trilobed with an eparterial bronchus, whereas the right-sided lung is bilobed with a hyparterial bronchus. The liver is located left of the midline, and the stomach and spleen are on the right.[1,2]

Dextrocardia in combination with SIT is a rare congenital anomaly with a frequency of 1:10 000. Whereas cardiac abnormalities associated with isolated dextrocardia occur frequently, dextrocardia with SIT is rarely associated with congenital heart defects, with an incidence ranging from two to 10%.[3] In patients with dextrocardia as a part of SIT, coronary heart disease may occur with a similar frequency and manifestation as in the general population.[4]

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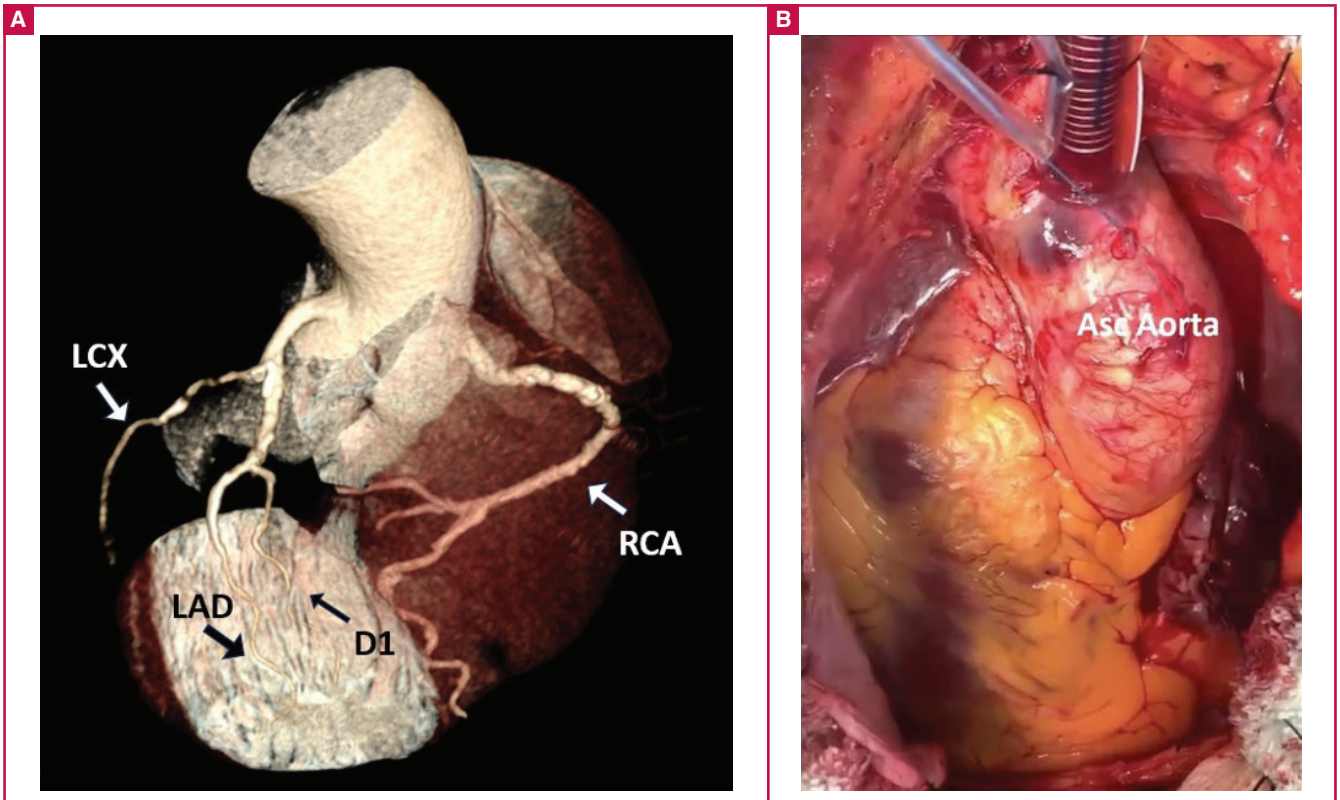

Fig. 1. A. Volume-rendered CT images from the anterior view show the heart as a mirror image, with the cardiac apex located on the right. RCA: right coronary artery, LAD: left anteror descending artery, LCx: left circumflex artery, D1: first diagonal branch. B. Intra-operative image of dextrocardia. B. Intra-operative image of dextrocardia.

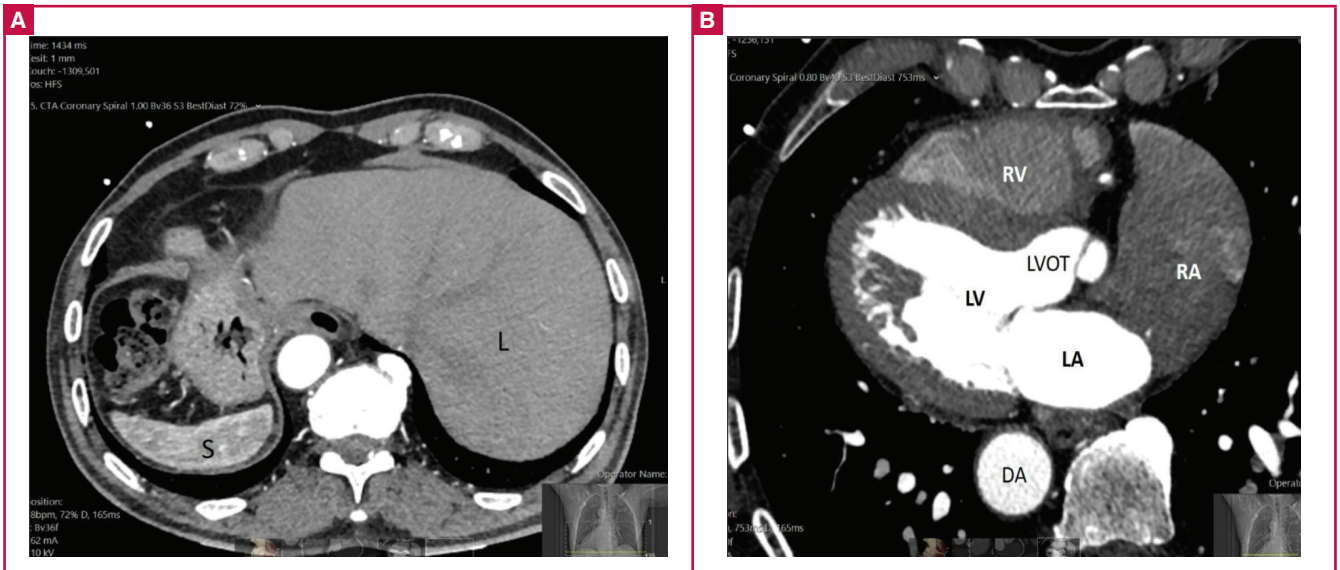

Fig. 2. A. Axial image through the upper abdomen showing the liver (L) in the left upper quadrant and spleen (S) in the right upper quadrant. B. Axial image at the level of the cardiac chambers shows the morphological left atrium (LA) is connected to a morphological left ventricle (LV), and the morphological right atrium (RA) is connected to a morphological right ventricle (RV). Continuity between the left ventricle and the left ventricular outflow tract is seen. The desecending aorta (DA) is located in the right hemithorax.

The high negative predictive value of normal CCTA images can effectively exclude significant coronary artery disease (CAD), thereby avoiding the need for further imaging tests and reducing the need for ICA as the first-line investigation in patients with low to intermediate risk of CAD.[5] CCTA is superior to ICA in evaluating coronary artery anomalies because it gives a better

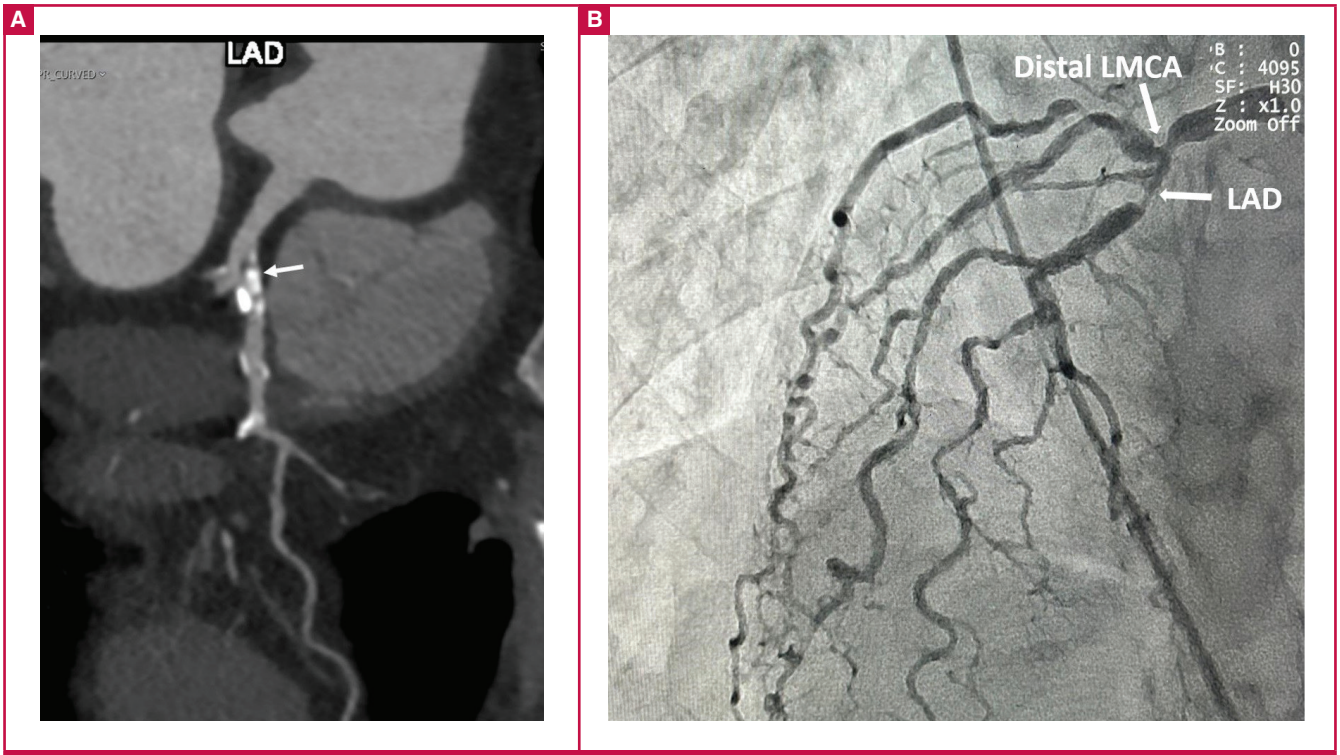

Fig. 3. A. Curved reformatted images of the left coronary artery showing extension of high grade stenosis from the distal left main coronary artery to the left anterior descending artery (white arrow). B. Invasive coronary angiography of the right cranial image of our patient (typically a standard left cranial image of a normal patient).

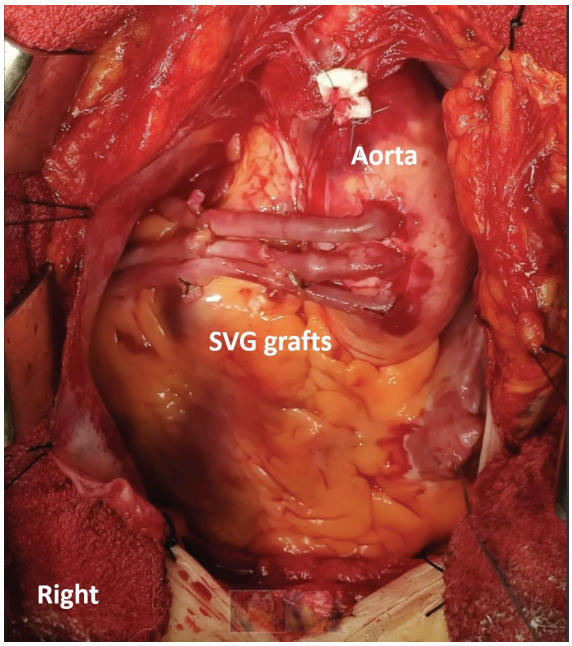

Fig. 4. CABG with full venous grafts.

anatomical depiction of the coronary arteries and more clearly shows anomalies in their origin, course and termination. CCTA is also useful for accurately assessing coronary artery origins, particularly for preprocedural planning of difficult coronary artery catheterisation.[6,7] We chose CCTA as the primary option for evaluating patients with SIT due to the anticipated challenges involved in performing ICA in the presence of dextrocardia before advanced examination and treatment, such as percutaneous coronary intervention or CABG.

The primary dispute in the medical literature concerning CABG for patients with dextrocardia involves the standing position of the operating surgeon, to the left or right side of the patient during the operation. In our case, the surgeon anastomosed the LAD and diagonal-1 arteries while standing on the right side, which is the typical surgical position. However, the LCx artery was anastomosed while standing on the left side, which is opposite to the usual surgical standing position. To the best of our knowledge, this case is the 38th reported dextrocardia CABG case in the medical literature.[3]

Conclusion

Cross-sectional imaging with CT is a valuable method in the evaluation of anatomical relationships. In this case with situs inversus and dextrocardia, a cardiac CT scan clearly demonstrated the mirror-image location of the intra-abdominal solid organs, cardiac cavity and coronary arteries. With the current technological developments, critical stenosis in the coronary arteries can be detected with CCTA examination. CT imaging can serve as a detailed roadmap by visualising the variable anatomy and coronary artery locations, ostia and stenosis in SIT. With the use of volume-rendered three-dimensional and curved reformatted images reconstructed from CCTA, the advance of catheters and guidewires during invasive coronary angiography and planning of surgical procedures can be performed more safely.

References

1. Wolla CD, Hlavacek AM, Schoepf UJ, Bucher AM, Chowdhury S. Cardiovascular manifestations of heterotaxy and related situs abnormalities assessed with CT angiography. *J Cardiovasc Comput Tomogr* 2013; **7**(6): 408–416.
2. Maldjian PD, Saric M. Approach to dextrocardia in adults: review. *Am J Roentgenol* 2007; **188**(6 Suppl): S39–49; quiz S35–38.
3. Oi A, Tatsuishi W, Mohara J, Yamamoto T, Abe T. Coronary artery bypass grafting in a patient with situs inversus totalis: a case report. *J Cardiothorac Surg* 2022; **17**(1): 56.
4. Hynes KM, Gau GT, Titus JL. Coronary heart disease in situs inversus totalis. *Am J Cardiol* 1973; **31**(5): 666–669.
5. Miller JM, Rochitte CE, Dewey M, *et al*. Diagnostic performance of coronary angiography by 64-row CT. *N Engl J Med* 2008; **359**: 2324–2336.
6. Ngam PI, Ong CC, Chai P, Wong SS, Liang CR, Teo LLS. Computed tomography coronary angiography – past, present and future. *Singapore Med J* 2020; **61**(3): 109–115.
7. Karabay KO, Yildiz A, Geceer G, Uysal E, Bagirtan B. The incidence of coronary anomalies on routine coronary computed tomography scans. *Cardiovasc J Afr* 2013; **24**(9): 351–354.